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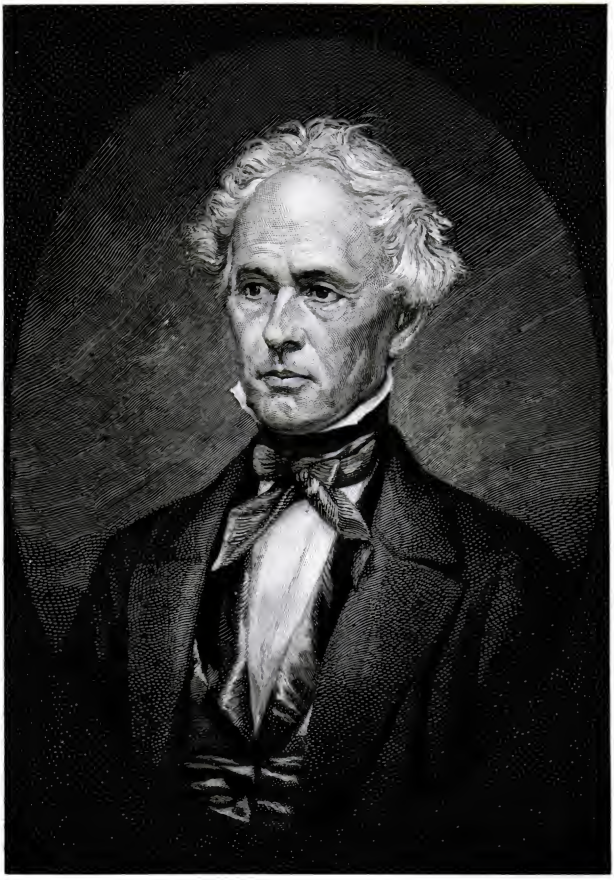

WILLIAM C. REDFIELD

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THE MORAL STANDARD.

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IN the present paper I purpose to discuss briefly the nature of the moral standard, strictly so called. The simplest way of approaching the subject will perhaps be to pass in rapid review the other principal criteria of conduct, by contrast with which the essential character of the moral criterion itself will be brought into conspicuous relief.

From the study of the world's culture history it becomes clear that the extra-moral, or what we shall here call the pre-ethical standards of conduct, have arisen from three different roots. As we shall presently see, these roots ultimately run into one, as looking at the matter from the evolutionary standpoint we should of course expect; but inasmuch as the criteria developed by them are in their later forms sharply marked off from one another, it will be desirable for the sake of clearness to treat them separately. The three principal roots, then, out of which, apart from the true moral root, the influences governing and directing men's lives have arisen, are: (1) The theological or religious root; (2) the social or ceremonial root; and (3) the legal or political root. We will examine these one by one:

1. All religions as they pass out of the primitive cult stage of ancestor-worship originate certain specific rules of conduct, which, as they consolidate, grow up into a more or less definite code. For the source and power of such a code we have not far to seek. Arising at the outset from the personal mandates of the deified ancestor or chief, the directions concerning action emanating from this quarter gradually assume a more emphatic, mysterious,

and impressive character, as with the merging of many tribal deities into a national god, and of various national gods into a single supreme power, they come to be regarded as the supernaturally given utterances of the invisible, omniscient, omnipresent, but still manlike governor of the universe. The precept or direction, therefore, takes the form of a command, and right and wrong in action are made synonymous with obedience or disobedience to such command. Along with development in definiteness and consistency of a code thus made up goes increasing stress upon the pleasures and pains by enunciation of which the commands are accompanied. Right action, or obedience to the will of the divine ruler, is attended by divine approval, and is fostered by promises of heavenly reward; wrong action, as disobedience to his will, calls down divine anger and the threat of penalties in the future life.

Whatever may be the particular differences separating the various theological codes of conduct from one another, they thus reveal striking similarities in sundry important respects. With greater or less distinctness they all claim supernatural origin; establish their behests and their interdicts upon the basis of external, ultra-human yet still manlike authority; and find support for their declarations in the presentation of consequences lying outside the natural order. The theological system of conduct of the low savage tribe and that developed among the nations of the civilized world of course differ in the character of the acts distinguished as good and bad, in the quality of the rewards and penalties offered, in the attitude of mind encouraged, and in other equally significant ways. Yet they have these points in common: the commands are supernatural, the sanctions are supernatural, the code is based upon ultra-rational considerations and backed by the presentation of ultra-rational results.

That it is the theological code of conduct which, throughout the Christian ages and down even to our own day, has been almost universally accepted as the one possible foundation of morality, we need not here pause to insist. If the tables of the law given to Moses on Mount Sinai are not still regarded as the original source of our knowledge of the distinctions of conduct, there is still a tacit belief that such knowledge depends upon supernatural revelation. As by one course or another, therefore, our commonly held ideas of morality lead us back to the theological root, it will be well to note the bearings of theological principles upon the questions with which morality is concerned. The following points are, I think, specially worthy of attention:

Since the theological code of conduct regards virtue simply as obedience to divine command, and measures morality by the correspondence of action with the divine will, we are bound to infer

that right and wrong have in themselves no inherent quality, but are made so simply by the enactment of an external power. The quality of a line of conduct thus resides not in essentials—the intrinsic tendency of an action and its bearings upon life, but in non-essentials—the accidental fact that it is forbidden or enjoined by God. For example, Jehovah lays certain restrictions upon the man and woman in the Garden of Eden; and disregard of these restrictions is sin. He commands Abraham to commit a horrible crime, and because of his readiness to do so he is paraded before us as the father of the faithful and a model for our own imitation. For a direct statement of the position here indicated, reference may be made to No. XIII of the thirty-nine articles of the English Episcopal Church. The unmistakable meaning of this article is that a good deed, such as the gift of a cup of cold water to a thirsty wayfarer, has in itself no inherent quality of goodness. Performed in a state of grace and from faith in Jesus Christ, it is well-pleasing to God, but only on that account. Let the blessing be offered, not out of faith in Christ, but from spontaneous sympathy with suffering humanity, and what has official theology to say to the matter? "We doubt not that it has the nature of sin."

Implied in all this of course lies the further fact that morality looks Godward and not manward. Sin is sin because it is unpleasing to God, not because it is injurious to man. How disastrous the effects of such a conception as this may be, the history and literature of Christendom are at hand to show us. If such an astute thinker as Duns Scotus, insisting on the perfect freedom of the divine will, could declare that if God had prescribed murder and theft, murder and theft would not have been sins; if a high-minded moralist like Sir Thomas Browne could write, "I give no alms to satisfy the hunger of my brother, but to fulfill and accomplish the will and command of my God," it may be taken for granted that, in the average of cases, such a view of conduct could not but be degrading to those entertaining it. Out of this view sprang the belief, widespread throughout the middle ages and continuing down to our own day, that a man may clear his conscience of the burden of wrong acts by making his peace with God. Given the point of view, and this conception is strictly logical; since God is the person offended, and his pardon will make all right again. Formerly, people endeavored to compound for the sins of a lifetime by building churches, endowing monasteries, or leaving their ill-gotten wealth to the priests. In our own epoch the old belief lingers on in the orthodox doctrine of penitence and the forgiveness of sin.

Beyond all this, it is of the nature of a theological code of conduct to get the important and unimportant in action sadly

mixed up together, and even to cause them occasionally to change their places. Thus, in our own *régime*, undue emphasis is habitually laid upon the ceremonial side of life. Examination of the Ten Commandments reveals six that are roughly describable as utilitarian, the remaining four (a large proportion) referring to religious observance. In common conversation, attendance at church, and careful regard for other so-called religious duties are habitually placed on a level with, or even higher than, the careful fulfillment of secular requirements. Popular ideas concerning the Sabbath furnish a striking illustration of the point to which we now refer.

2. We pass now to the pre-ethical code of conduct arising from what we here term the social, or, better, the ceremonial root.

Casual consideration might lead one to suppose that ceremonial factors have played a relatively unimportant part in the history of civilization. Such a supposition, however, as further investigation could soon prove, would involve an entire misapprehension of the facts of human development. Indeed, strictly speaking, it is with the ceremonial code that such a discussion as this ought to begin, since out of it, in the consolidation of social life, both the regulations that we call religious and the regulations that we call political have been gradually evolved. Ceremonial government, as Mr. Spencer has shown, is not only the earliest and most general kind of government, but is also a government which "is ever spontaneously recommencing." Moreover, it has ever had and continues to have, as the facts of daily existence show us, the largest share in regulating men's lives.

It thus happens that distinctions of right and wrong constantly refer to a standard of convention, all questions of the tendencies of actions and of their wider relations to life being consciously or unconsciously left out of account. Like the theological code, therefore, the ceremonial code habitually passes over the inherent qualities of actions. Its sanctions are generally extraneous, not essential, and its inevitable trend is to confuse the really important with the relatively unimportant in conduct, often with the most unfortunate results. How far the ceremonial code demands respect, to what point it is mainly useful, and under what conditions it passes into a tyranny, crushing individuality and repressing the vital forces of life, are questions which, though to the last degree important, can not here be considered. What we have now to do is to notice the wide area over which the social code operates; the imperative character of its enactments; and the confusion to which it frequently gives rise—a confusion resulting from the fact that in the conflict of influences by which we are daily met, the morally right is again and again sacrificed to the socially correct. The "proper and therefore wrong" of

one of our writers is indeed a piece of merely rhetorical exaggeration, but the distinction between rectitude and propriety—between the criterion of the moral and the criterion of the social code—has none the less to be emphasized.

3. In the early stages of social evolution custom tends to harden into definite precept; hence the third pre-ethical standard of conduct—the legal or political standard. Guidance by custom is, as I have above implied, the primordial form of guidance in the low tribal group; but out of this arise gradually both the sacred law, or the command of the deified ancestor or chief, and the secular law, or the command of the living ruler. At the outset, indeed, no distinction between sacred and secular is to be made, the enactment of the chieftain, while he is still alive, passing insensibly into a religious enactment when, dying, he takes his place among the tribal gods. But differentiation presently begins, and it is with the secular side of the matter after such differentiation that we are now concerned. Law, then, emerges when the spontaneously evolved customs of a social group are gathered up and crystallized in the dictates of the strong man or chieftain, and when vaguely diffused social sentiment thus receives distinct formulation and powerful personal support.

It is evident that from the legal as from the theological point of view right and wrong are primarily associated with obedience and disobedience to external authority. Conformity to the particular requirements of the established body of laws implies allegiance, and allegiance is virtue; while insubordination constitutes the very essence of evil, the element which makes crime crime. The sanctions of the legal code are, therefore, once again extraneous sanctions; its restraints and incentives, penalties and rewards, imposed from the outside.

Thus, comparing the three principal pre-ethical codes with one another, we find them characterized by certain important points of similarity. In each case fortuitous and not necessary consequences of action have been taken as the basis of restraint; in each case outside compulsion has furnished the required impulses and deterrents; in each case, therefore, the sanctions have been almost entirely accidental and extraneous, and not to any adequate extent fundamental and essential.

And now we have only to place the moral code alongside of these pre-ethical codes in order to throw its radical and differential qualities into immediate and striking relief. For what is the code of morality strictly so called? It is the code under which actions are classified in virtue of their essential natures—that is, of their necessary bearings upon life. It formally postulates as the ultimate end of conduct that which, after all, we find implied in a more or less crude and confused fashion in all ethical sys-

tems whatsoever—well-being; and it considers conduct in its direct or indirect relation to that end—that is, in the connection of actions immediately with well-being, or mediately with the conditions prerequisite to its attainment. Its fundamental assumptions are therefore at once simple, and, despite all *doctrinaire* theorizing to the contrary, practically though latently universal. We are alive. This is obviously for all of us the final fact, and no less obviously every proposed test of life's activities must ultimately be resolved into terms of this unresolvable first principle. Now, the facts of actual life favor neither the fatuous preconceptions of the optimist nor the equally wild asseverations of the pessimist. We can not assert, with Malebranche and Leibnitz, that this is the best of all possible worlds; or with Hartley, that "all individuals are actually and always infinitely happy"—a proposition which, as Mr. Leslie Stephen has well said, sounds like optimism run mad. But neither, on the other hand, can we accept the dogma of Chabot, that what we mistakenly call the cosmos is really the work of a crazy devil; or follow Schopenhauer in his statement that the universe is just as bad as it conceivably could be without falling to pieces altogether; or treat seriously the suggestion of Novalis, that the simultaneous suicide of all human creatures is the one way of escape from miseries that are both unbearable and irremediable. Optimism would logically negative any attempt to tamper with the facts of a world wherein it has already pertly concluded that whatever is is right; pessimism no less inevitably leads to a like passivity by treating life in its essence as radically too evil a thing to be susceptible of any improvement. But life, as I have said, fits the theories of neither pessimist nor optimist. It is not wholly bad, it is not wholly good; it is a thing of mingled yarn, good and ill together, with immeasurable capacity, in its higher forms especially, for the development of one element or the other. Moral conduct I therefore conceive to be, in a single phrase, conduct which betters existence, which adds to its sum total of happiness or decreases its sum total of pain. Action which makes life as a whole more fully worth living is as such right action; action which diminishes its value is as such wrong. The results upon which morality thus bases its incentives and restraints are therefore the actual results involved in the very constitution of things and not consequences artificially imposed by any external power. We reach in this way the ultimate conception of the immanent moral law, and for myself I see no way either of avoiding the resolution of all other possible criteria of conduct into the criterion thus established, or of getting behind such a standard in search of a final principle of a more universal, fundamental, and axiomatic character. Here, and here alone, it seems to me, we strike bed-rock.

The moral motive, therefore, arises not by contemplation of the gratification given by a certain line of conduct to God, or by recollection of superimposed pleasures, secular or supernatural, present or future; or by any reference to the social habits or conventions with which the said line of conduct may or may not accord. Such moral motive has nothing to do with obedience to the revealed will of God, or with the extraneous conceptions of heaven and hell, or with punishment or reward from earthly rulers, or with the favor or disfavor of public opinion. It arises from the vivid ideal representation of the relation between action and life. The compulsion of morality, therefore, is inner and not outer compulsion, its authority inner and not outer authority, its restraints those arising from the connection of cause and effect, its sanctions natural, not supernatural, essential and not fortuitous. The foundations of the moral code thus belong to the very nature of sentient life itself, and its dictates therefore possess a validity, a reach, a significance, a sacredness, to which no others can conceivably lay claim.

And here, perhaps, to prevent possibility of misconception, something should be said about the relation of the moral to the cosmic process. Briefly, then, I accept in the main the position adopted by the late Prof. Huxley in his Romanes Lecture on Evolution and Ethics. That there is a fundamental distinction between the "state of Nature" brought about by uninterrupted cosmic forces, and the "state of art," produced with partial success by the rational power of man, working sometimes with but often athwart those forces, and that reason and sympathy—the latter constituting by all odds the most important element in the social tissue—have brought entirely new dynamic factors into play upon the arena of life, are propositions from which I see no way of escape. It can not be too frequently asserted that what we call the order of Nature is not an ethical order at all—that the laws of Nature, as such, have nothing to do with morality. The ethical element begins, I think, faintly to emerge with the relation of sentiency to those laws, though the establishment of a moral order depends entirely upon the "artificial" factors introduced by the consciousness of man. It is, of course, true that these "artificial" factors are themselves products of cosmic processes, and that the order out of which they have grown itself imposes limitations of the severest, and often the narrowest, kind to man's intelligent reaction against it.

> This is the art which does mend Nature, but
> The art itself is Nature.

Nevertheless, for the sake of clearness, the contrast of the "natural" and the "artificial," of the workings of Nature apart

from the interference of man and the workings of Nature *plus* such interference—in a word, of the cosmic and the ethical—has to be insisted on. Nature has achieved certain results, though by slow, blundering, and (Montesquieu notwithstanding) extravagantly wasteful methods. Her processes, however, with all their, to us, ruthless cruelty and prodigality, have, in the rough average of cases, made for what—rather metaphorically, perhaps—Mr. Spencer has called "fullness of life"; and such increasing fullness of life may therefore be described—to borrow a teleological phrase, though I do not myself accept the teleological implication—as the "end" of evolution. And here it is that reason steps in and seeks, within the limits everlastingly imposed by cosmic conditions, to find means helping to the same great "end"—now a true rational end—which, while at least as effective as the methods employed by Nature, shall be no longer characterized by what in the "acquired dialect of morals" (to use Huxley's phrase) we have learned to call Nature's indifference and brutality. Man, then, by reason of his intelligence, has great power of tampering with the cosmic order; and how far it is wise to do this and just where the proper compromises have to be made remain to-day among the most difficult of the social problems which we have to face, though in view of the foregoing discussion we may lay it down as a general principle that the ethical process should be allowed to interfere with the cosmic process only when the "end" aforesaid may be more adequately, perfectly, and economically secured thereby. At any rate, we must admit that Goethe was right when he said that it is man's privilege to "distinguish, elect, and direct,"* and Arnold when he wrote, "Man must begin, know this, where Nature ends."†

Returning from this digression, we will consider for a moment the evolution of the moral code as above defined.

When I described the earlier and outward regulative codes of conduct as pre-ethical codes I did not simply mean that in the sequence of human affairs they actually came before the moral code itself. The relationship is closer and more vital than such a statement would imply. My full meaning is that the pre-ethical codes have all along combined to establish and maintain the social conditions, in the absence of which no observations of cause and effect in conduct could have been made and registered—in the absence of which, therefore, the moral criterion strictly so called would never have arisen. As out of the primordial ceremonial code arose the codes we call religious and political, so out of these combined has gradually emerged and differentiated the moral code proper, as with that consolidation of social life to

* *Das Göttliche.* † Sonnet: In Harmony with Nature.

which ceremony, law, religion, morality, have all tended, men have come slowly to understand that in the recognition of conduct and consequence as everlastingly united in the category of cause and effect lies in all questions of action the one valid, authoritative, and final court of appeal.

"Might till Right is ready," said Matthew Arnold, and in the civilization of the race the might of the outward authority—supernatural, political, social—has gone before and has prepared the way for the right of the inward authority we describe as moral. Men have been trained to the self-compulsion of the moral motive by enforced obedience to the external compulsions of ceremony, religion, law. The strong hand of the earthly despot, only gradually relaxed as the education for freedom went on; the binding power of tyrannic custom, following life into the minutest recesses of its daily routine; the drastic force of supernatural pleasures and pains, meted out by a personal but omniscient deity who exacted unquestioning allegiance and punished every infraction of his commands—all these elements were required as formative factors in the moral development of mankind. The condition of heteronomy must in the nature of things precede the condition of autonomy, and we only pass from general principle to particular illustration when we say that the outward authorities above dealt with were inevitable prerequisites to the inner authority of morality in the order of the evolution of human life.

Yet it must be remembered that in an indistinct form the moral sanction proper very early began to emerge as an influence in social growth. Natural selection was from the beginning concerned in the picking out and perpetuation of certain qualities—egoistic and altruistic—making for the welfare and expansion of society; and unconsciously at the outset such qualities naturally came to be registered and emphasized in the ceremonial, religious, and legal codes. Among moral characteristics thus nurtured in the primitive stages of political consolidation may be mentioned loyalty, courage, obedience, without which no successful tribal warfare could be carried on, together with a rudimentary form of justice, veracity, and general sympathy, without which the group could never survive in the face of antagonistic tribes whose social feelings were more highly evolved. As the struggle for existence has all along been a struggle among groups as well as among individuals, a premium was laid from the very start upon whatever qualities, altruistic no less than egoistic, would make for social strength and efficiency. These qualities were early caught up in the life and feeling of each developing group; an ideal answering in its larger aspects to the fundamental needs of the tribe was thrown up; and the vague encouragement yielded by

diffused public sentiment was presently backed by the sanctions of law and religion. But, later, another element little by little comes into play. With intellectual progress men begin slowly to realize that certain lines of action make for tribal welfare, and certain other lines to tribal disadvantage; that these observed bearings and results are altogether independent of social custom, the commands of the chief, the utterances of the gods or god; and that thus there is a sanction for conduct deeper and more stable than those currently assigned. Throughout the further evolution of humanity, and down even to our own time, these observed connections between conduct and its consequences continue, it is true, to be interpreted mainly through the medium of the earlier codes—that is to say, even where the natural criterion for conduct is dimly perceived, artificial restraints and incentives are still to the fore. Yet a great gain is none the less achieved, since if the evolving moral code does not replace the earlier codes, it more and more comes to constitute a kind of final standard, by correspondence with which the precepts of such earlier codes may be tested.

We are thus forced to the inference that in the continued evolution of life and thought the ethical criterion of conduct will detach itself more and more completely from the other criteria of which we have spoken, and will be more habitually referred to as the touchstone by which right and wrong in action alone are to be decided. Especially in view of the rapid spread of scientific habits of thought does it seem likely that such a result will be brought about; since the central principle of science—the principle of natural causation—is precisely that which underlies the moral code, with its interpretation of conduct and consequence in terms of cause and effect. This does not, of course, mean that guidance and inspiration from other quarters will not constantly be sought, or that all impulses that we should here, strictly speaking, call ultra-moral impulses, will be entirely disregarded. But it does certainly mean that there will be an increase of the already manifest tendency to hold in view the ethical criterion as the ultimate test of conduct, to interpret every side of life's activities more constantly in terms of this, and to insist that in every case of discord between the criterion of morality on the one side and any other lower criterion whatsoever upon the other, we shall revise our principles and our practice without hesitation or demurrer, in such way as to bring them into fundamental harmony with the dictates of the moral law.

And here a very serious question arises. In tracing back the radical distinctions of right and wrong to purely naturalistic sources, do we detract in any way from the authority, the im

perativeness, the peculiar sanctity and importance of the ethical code? What, in other words, are the remote emotional tendencies involved in the treatment of conduct from the evolutionary point of view here assumed?

I regard this matter as of especial moment on account of the recent contention of Mr. Balfour (1) that practically "no moral code can be effective which does not inspire, in those who are asked to obey it, emotions of reverence; and (2) that practically the capacity of any code to excite this or any other elevated emotion can not be wholly independent of the origin from which those who accept that code suppose it to emanate."* I assent to both these propositions, while I most distinctly join issue with the writer in his inference that by the precepts of the naturalistic moral code the higher emotions, which he rightly holds as fundamentally necessary, can not possibly be called forth.

The gradual decline of the older theology will, I am convinced, bring with it no decadence in our feelings of awe, reverence, sacredness, mystery, but simply a transference of these feelings from the so-called supernatural to the natural—from the power manifested in miracle to the power revealed in law. And thus, by a gradual but inevitable process of adjustment, will it be without possibility of question, when the naturalistic ethics of the future shall have taken the place of the supernaturalistic ethics of the past. Of the moral ideal it may thus be said that it "decomposes but to recompose" with fuller beauty and richer meaning. Rooted fast and deep in the very constitution and conditions of life, itself part of the everlasting order of cosmic growth, written on no tables of stone to be broken or crushed under foot, graven on no page of human fashioning to be torn or obliterated or otherwise destroyed, the moral law thus indeed reveals itself as the eternal law—the utterance and the declaration through the universe itself of that power of which this throbbing world of life and sense and thought is, after all, but the garment and partial expression. Over the unshaken foundations of such a faith as we can thus make our own, the tides of time and change wash and curl in vain. Creeds and speculations, precepts and philosophies, pass away and are forgotten, but such a faith indeed endureth forever.

That to affiliate ethical principles in this way upon natural law adds immeasurably to the deep and terrible responsibilities with which life is coming to confront the modern man, must be acknowledged. From no other point of view does the high seriousness of conduct, the imperiousness of duty, the strenuousness of living, become so emphatic; in no other way are we forced to

* The Foundations of Belief, p. 13.

so tremendous a realization of all that is meant by the fatal chain of action and consequence—a chain the links of which, fragile and delicate and silken as they may seem, are yet woven in the loom of eternity, and are never to be swept asunder. "Not heaven itself upon the past hath power." Injustice, dishonesty, impurity, wrong of every kind, will and must, in the everlasting order of the world, work out their inevitable results, all our prayers, all our remorse notwithstanding.

> . . . There's not a crime
> But takes its proper change still out in crime,
> When rung upon the counter of the world;

and in the administration of the moral law there is no favoritism, no bribery, no loophole of escape.

While the deep realities of existence are thus made deeper and more real, and while the earnestness of conduct and the solemnity of true thought as well as of right action are thrust into almost awful relief, we are forced, moreover, to give up, one by one, the radiant visions of future progress which for thinkers of widely different schools have touched with the glory of infinite promise the hard and obstinate facts of life. The ghost of Malthus has hardly been laid even by Spencerian incantations; and the splendid dream of perfectibility, of the final evanescence of evil—in which the great evolutionary philosopher once loved to indulge—is, we must confess it, only a dream after all. The theory of evolution, as Huxley has said, "encourages no millennial anticipations." The rhythm of life means the ultimate undoing of all that can be done. "Many a planet by many a sun may roll with the dust of a vanished race"; and the time must come, in the dim and mysterious future, when our planet shall be one of these—when, in the striking words of Mr. Leslie Stephen, the earth shall "become a traveling gravestone, and men and their dreams shall have vanished forever." Hence, to quote the same thoughtful writer, "we must be content with hopes sufficient to stimulate action," and must believe "in a future harvest sufficiently to make it worth while to sow, or, in other words, that honest and unselfish work will leave the world rather better off than we found it." And when we study life at large from the point of view here adopted, it may surely be urged that a large basis of substantial hope is given in place of the fallacious and illusory hopes that have been snatched away. A universe of law is, after all, a universe that we can trust. Science teaches us to have confidence in the nature of things; and cause and effect, as Emerson put it, are indeed the "chancellors of God." How would any such confidence be possible if the world were actually governed by caprice, chance, miracle? It is because we can throw our-

selves boldly back upon law, because we can interpret human progression, within the limitations by which it must everlastingly be circumscribed, not as an accident, but as part of a gradual and orderly unfolding of cosmic processes, that we can still hold fast to our faith on the one hand, in the permanent significance of duty; on the other hand, in the fundamental actuality of human aspirations. We said just now that we find inspiration to sow the seeds of action only by reason of our faith in the harvest of results. Well, science holds out no promise of the visionary harvest of a "far-off infinite bliss"; but it gives us definite assurrance of what, after all, is of vastly greater consequence to us—the steadily growing harvests of the years immediately to be. Little as each more separately can do, that little is thus seen to be well worth the doing; and the old message comes down the ages to us with ever-renewed force—"Work while it is yet day, for the night cometh when no man can work!"

PUBLIC AQUARIUMS IN EUROPE.

By BASHFORD DEAN,
COLUMBIA UNIVERSITY.

THE life of the sea has ever had a peculiar interest to people of every class and calling—the strange and bright-colored fishes, the sea stars and anemones, the rich forests of seaweeds, the ghostly and luminous jellyfishes introduce to their observers a submerged world which bears with it every charm of the unreal and the unknown. A feeling of awe is not absent in the long, dusky corridor of an aquarium, as with hushed voices the visitors are gazing through the bright-colored windows; through each they may see the depths of a miniature ocean. Here a common interest brings together visitors of every class, and in the changing crowd are strangely mingled types of faces—refined, illiterate, scholarly, rustic—all fixed and earnest, absorbed with the brilliance and variety of the ever-changing scenes. Within the entrance of a gallery a number of sailors have long stood motionless before one of the larger tanks, watching the undulating movements of the swimming ray and the feeding of a dull-looking shark, with perhaps none the less interest that they have seen these fishes many times before. A few yards away a group of children are visiting the aquarium for the first time; they stand spellbound, gazing open-mouthed at the graceful movements of a sea horse; or is it that they have discovered the large eight-armed cuttlefish which is slowly writhing itself into a less conspicuous corner of its rocky den? And yonder a gray-bearded

Russian zoölogist—noted enough if one were to give his name—is taking the opportunity of examining for the first time a clump of living crinoids.

The aquarium is altogether a modern institution, dating back scarcely more than a third of a century. Its practicability appears to have first been prominently brought before the public by an Englishman, Mr. W. Alford Lloyd, who during the sixties took an active part in the founding of the aquariums of Paris (that of the Jardin d'Acclimation), Hamburg, Hanover, and of the Crystal Palace, then the most famous of all. In fact, it was notably due to his efforts that throughout Europe aquariums became fashion-

THE NAPLES AQUARIUM.

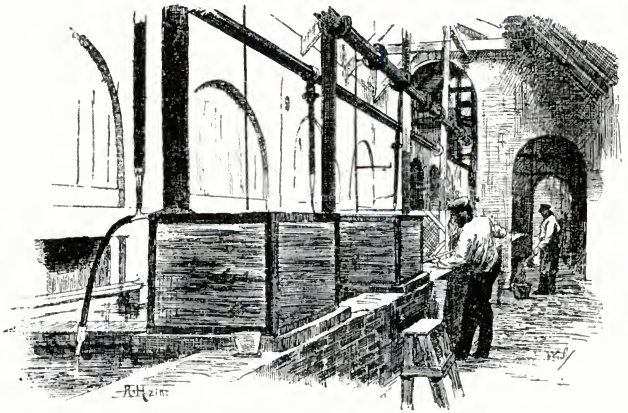
able, to a degree indeed which caused the great cities to vie with each other in their prompt efforts to build and equip them. In those early days the style of the buildings was prevalently grotto-like. To see the fishes one was to be given the impression of actually going deep into the sea by descending first into a cavern, down rock-cut steps to the murmur of trickling (if very artificial) brooks. These early aquariums, of great interest from the standpoint of naturalism, were at first exceedingly popular, amply remunerating their stockholders when organized by private capital. Some of these, however, owing in nearly every instance to injudicious management, came later to deteriorate, and after becoming concert halls, or adding circuslike attractions, have ultimately failed.

THE AMSTERDAM AQUARIUM.

At the present day it has become a difficult matter to classify the various aquariums of Europe, since they present so wide a range in size, quality, and purpose. Some are destined solely for the public use and can not be said to be of aid to scientific studies; others are devoted almost entirely to the advancement of biological research; and others still vary widely between these extremes, with an equally wide range in the character of their financial support. Many of the aquariums of the orthodox biological stations, however, have been situated in out-of-the-way places, convenient for the purposes of the student, but inaccessible to the general visitor. These may be admirably arranged and maintained —among them, for example, the aquarium room of the French station at Banyuls, on the Mediterranean, near Spain—yet they can not be strictly regarded as belonging to the class of public aquariums. For this reason, partly, more than a score of biological laboratories might at once be omitted from discussion. On the other hand, the Stazione Zoologica of Naples, while devoted to the highest type of research work, must be given the foremost rank among popular aquariums. And the Amsterdam Aquarium, holding rank on the popular side probably second to Naples, is also of value as a purely scientific station, although lower in caste than the Stazione. So, too, should the Plymouth Biological Laboratory be mentioned as of interest in its well-equipped aquarium. Together with those that have just been mentioned, the more strictly popular aquariums of Europe should include those of Paris, Berlin, and Brighton.

These aquariums are so widely separated from each other that they have come to differ not a little in the details of their equipment and management. And it is, indeed, only when the visitor has examined a number of these institutions that he begins to realize that there is a common principle underlying their general construction. Thus, for example, he would find in each the great darkened corridor, from which on every side, as through large windows, he may look into the brightly lighted tanks. Through these he may peer to a distance of twenty feet before his view is stopped by the rough, rock-cut background; nor does the line showing the surface of the water appear against the glass to destroy his illusion of ocean depth. The cunning builders have taken pains to have this line higher than the windowlike opening of the tank, so that the water surface, instead of marring the effect, in reality aids it, for the eye of the visitor, at a lower plane than the surface, sees upward but the totally reflected images of the forms below. Not that the glass fronts of the aquaria are exceedingly large—their height is rarely more than four or five feet in view of the danger of breakage through water pressure—although the idea of water depth is certainly not

sacrificed on this account, for the concreted bottom of the tank may be made to slope downward from the base of the glass plate till the needed depth is reached. Nor does the similarity in the various aquariums extend only to the corridor to which the general visitor is admitted. In their internal arrangements an even more strikingly similar ground plan is found to prevail. In all cases the attempt has been made to keep from the mind of the visitor the idea that water pipes, pumping engines, and blouse-wearing attendants—none of which withal are oppressively tidy—are necessary to the well-being of the tanks. And it is for this reason especially that the region behind the tanks is usually kept from profane eyes. Dark passageways lead to it, shielded



AMSTERDAM AQUARIUM—SERVICE OF THE BASINS.

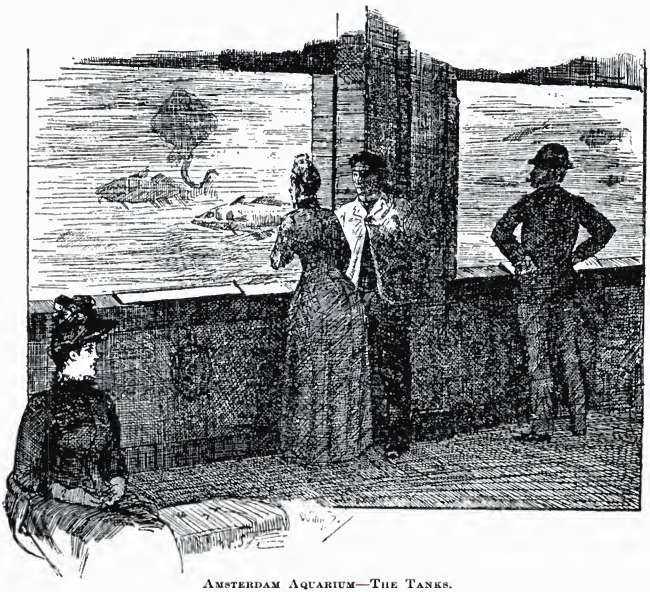
by hidden doors, and one who enters, coming from the dusky corridor, is at first blinded with a flood of light. Above him is the glass roofing of a conservatory, and sunshine is pouring down upon the rockwork of the tanks, thence to be reflected into the public hall. At his feet extends a concreted pathway; on either side are the tanks, or more strictly rock-lined pools, at whose farther ends can be seen the glass plates through which, in the corridor, the visitors are gazing. Above and around are serpent-like pipes, stretching at full length, abruptly coiling as they dip to the water surface or pass downward below the floor, a confusing maze, bubbling and hissing with steaming water. The system in the management of the water supply becomes, however, clearly understood when the mystery of strangeness has passed away. It has merely to conform to the hygienic law of its

inmates in providing that the water of each pool shall be clean and well aërated. To attain the former end, the water is constantly drained from the aquaria and replaced by fresh and filtered water; and to insure proper aëration, the incoming stream is usually passed into the tank in such a way that it draws downward with it in its current a cloud of air-bubbles—these to subdivide finely and to be in part absorbed. In the sea-water basins the "reservoir system" has been found most effective in securing the healthfulness of the water, and is at present in general use. It has certainly an advantage from the standpoint of economy, since by its means a given bulk of water may be used and re-used for months and even years, with better results, indeed, than if a fresh supply of sea water had been employed, for the latter, it is claimed, introduces a constant stream of impurities which can not be removed by filtration. The reservoir system is certainly an easy one to understand. In the basement or cellar of the aquarium building is situated a concreted cistern, whose capacity is ten to fifty times as great as that of the sum of the sea-water tanks throughout the building. In this cool, dark, and uniformly temperatured cistern the water seems to have the power, even in the course of a few days, to purify and "rest," its sediment settling and its air-drinking power becoming restored. It is into this cistern, accordingly, that the water drained from all parts of the building is returned after it has been roughly filtered; and it is directly from this cistern again that the water is pumped upward as the resupply. By this plan of circulation it is usually arranged that the water of each tank may become changed several times during the day.

From this review of the general subject we may next pass to the examination of the various aquariums of Europe.

NAPLES.—First in importance, as has already been noted, stands the aquarium at Naples, highest in rank, also, as a station of marine biological research. Its situation and surroundings are eminently attractive; it stands in a public garden on the side of the gulf, amid fashionable driveways, surrounded by bright-colored lawns and a wealth of century plants and cactus; in front are the outlines of distant Capri and the blue waters of the gulf; in full view is Vesuvius. The building itself is like a huge white palace, conspicuous from nearly every higher part of the city. Its main wing, shown in the foreground in the adjoining picture, is the older, dating from 1875, when the station was founded by Prof. Anton Dohrn; the wing immediately behind it is the newly built physiological laboratory. The aquarium occupies the basement of the main structure, and is open to the public daily, although to the rest of the building, including the laboratories, library, and rooms of investigators, strangers are not generally ad-

mitted. The doorway leading to the aquarium is shown in the illustration; through it one passes into the main corridor, a long, dark, concreted room, lighted only through wall-tanks, displaying admirably the showy fauna of the gulf, to which, indeed, the aquarium is largely indebted for its high rank. Imbedded in the walls of the sides and of the main partition of the room there are in all about two dozen large aquaria. In these the water appears clear and blue; their background of rough rockwork has been



AMSTERDAM AQUARIUM—THE TANKS.

so arranged that contrasts of bright lights and deep shadows throw in clear relief the colors of the marine life. In the first tank the visitor may find a collection of starfishes and sea urchins, some brilliant in color, clustering on the glass, each with a dim halo of pale, threadlike feet. In the background will be a living clump of crinoids, which flower out like a garden of stately and bright-colored lilies. A neighboring tank will be rich in dark seaweeds, and in its foreground a group of flying gurnards, reddish and brightly spotted, are feeling cautiously along the bottom with the fingerlike rays of their wing-shaped fins. Here, too, a small school of squid is swimming timidly to and fro like delicate and quick-moving fishes, and below them will perhaps be

a series of huge triton snails and the clustered eggs of cuttlefish. In another tank a bank of sea anemones exemplifies the large and gaudy forms common to southern waters—buff, orange, yellow, and vermilion—and there may be corals in the background, and a spectral forest of sea fans in white and violet, with a precious fringe of pink coral flowering out in yellow, starlike polyps. There may, again, be in a neighboring tank a host of ascidians, those curiously degenerate vertebrates whose stock could not have been widely unlike the ancestral stem of the fishes. Delicate, transparent, solitary forms, like the lanky *Ciona*, contrast with the deeply crimson *Cynthia* and the huge and mottled masses of many compound forms. Swimming about them may be chains of *Salpa*, and occasionally a number of *Amphioxus*, the latter to be seen only from time to time as they burrow out of the sandy bottom, flurry about as if in sudden fright, and quickly disappear. Variety is one of the striking characters of the arrangement of neighboring tanks. In one, brilliant forms outvie the colors of their neighbors. In another are examples of the closest mimicry of animals to their surroundings, where the stranger has often to examine long before in the seemingly empty tank he can determine on every side the hidden forms. Thus one by one will come into his view the rays and flounders, whose colors render them almost indistinguishable from the gravelly bottom; next he will see the upturned eyes of the curious stargazer, which lies almost buried in the sand; then a series of mottled crustaceans, wedged about in the rocky background, or an occasional crab which wanders cautiously about, carrying a protective garden of seaweeds on his broad, flattened back. Near by will be odd-looking pipefishes and the sea horses, poised motionless in mimicry of the rough stems of the seaweeds. In a larger tank, sea turtles float sluggishly about, and coiling amid broken earthen jars are the fierce-looking, snakelike, sharp-jawed murries, to suggest Roman dinners and the slave-eating experiments of the lordly Pollio.

The aëration of the aquaria is secured effectively by streams of air which are forced in at the water surface and subdivided into bright clouds of minute silvery bubbles. The tanks are cared for from the rear passageways, and the attendants are rarely seen, although it is the constant attention in the arrangement and the restocking of the tanks that has gained the aquarium its well-earned success. Illustrated catalogues in French, German, English, and Italian enable the stranger better to appreciate his visit.

AMSTERDAM.—The Amsterdam Aquarium is the most recent of the larger aquariums in Europe, dating from 1880. It was then opened, under the directorship of Dr. G. F. Westerman, as an ad-

Brighton Aquarium.

junct of the famous Zoölogical Society of Amsterdam, Natura Artis Magistra. The building itself is situated on the broad avenue margining the Zoölogical Garden, and is decidedly an attractive one, although outwardly as cold and dignified as the typical municipal building, with its Roman architecture and its central temple-like structure. Its large size, about a hundred yards in length, has been of great advantage in the arrangement of the details of the interior, permitting the decorative use of columns, arches, and cornices without noticeable sacrifice of space or the appearance of overcrowding. The main corridor, which the visitor enters after he has ascended a broad white stairway, is wide and stately, its marble walls and floor diffusing the light entering from the large glass faces of the aquaria. The corridor is about fifty yards in length, and the aquaria, twenty in all, are arranged on either side, the largest measuring about thirty feet. They have been admirably designed to display their collections of living forms; fishes are notably present, and on every hand their movement is incessant, with gleams of color and changes of outline as they sweep to and fro. The critical observer is particularly impressed with the great number of fishes which have been kept successfully in a single tank; among them he recognizes the prominent forms occurring along the North Sea coasts—turbot and sole, ling, cod, rays, and flounders—even the herring and mackerel, to which confinement is usually most fatal. A collection of fresh-water fishes is not lacking, including a number of American forms, for which the director has been indebted to Mr. E. G. Blackford, of New York city—black bass, amia, and catfish —the latter strongly contrasting in size with their European cousin in an adjoining tank, the giant *Wels* of the Danube. From the extreme end of the aquarium room the visitor passes into a smaller hall, circular in outline, which contains over a score of table tanks displaying forms of attractive fresh-water fishes and salamanders; it is brightly lighted and pleasingly decorated with a marble-tiled floor, fringed by palms and ferns. From this room an entrance leads, on the one hand, into a spacious auditorium, which is made of use in courses of popular lectures, and, on the other hand, by a few marble steps, into a well-lighted museum containing in several rooms a collection of dried or alcoholic preparations of the typical forms of invertebrates and lower vertebrates.

The operative portion of the aquarium includes well-lighted corridors extending on either side of the main hall; the pathway along which the visitor passes has been sunken below the walls of the tanks, whose shelving sides can thus be more conveniently reached by the attendants. A series of darkened corridors next lead into the vaulted basement containing the large storage tanks.

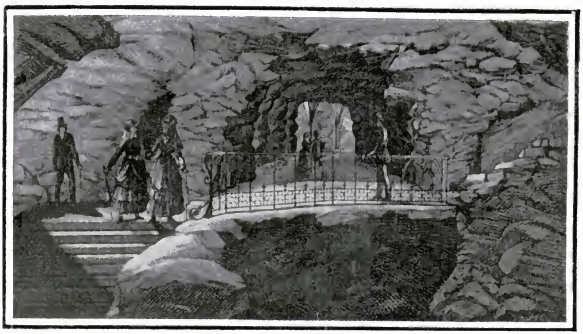
The administration of the aquarium appears throughout an especially painstaking and energetic one, due in no small degree to the labors of its present director, Dr. C. Kerbert.

BRIGHTON AQUARIUM—MAIN CORRIDOR.

PLYMOUTH.—On the Devonshire coast of England the need of a public aquarium has been supplied by the Marine Biological Association. In its laboratory building at Plymouth the entire

basement floor has been devoted to the interests of the general visitor, and a well-chosen collection representing the Channel fauna can be studied in its well-arranged tanks. The important work of the station in connection with the British fisheries, added to its exceptional advantages in collecting material, gives Plymouth an important rank among marine aquariums.

PARIS.—At Paris the Aquarium of the Trocadero was in its day—for it stands among the oldest—regarded as the foremost of Europe. At present, however, its condition is somewhat degenerate, and it is apt, partly on this account, to give the critical observer an unfavorable if not disappointing impression upon his first visit. It is ill kept, wet, and untidy; its tanks are poorly cared for and very imperfectly stocked; and the general absence of attendants has permitted many attempts at diamond writing on the costly glass plates of the tanks. These defects, however, do not prevent the visitor from finally recognizing the interest-



BERLIN AQUARIUM—THE THREE GROTTOES.

ing features of the aquarium. Its plan of construction, as in the earlier designs, is typically grottolike. Its main hall is subterranean, and the tanks appear at the surface amid a thicket of overhanging bushes, like a ring of natural pools. The public entrance is cavernous—a descent of rough-hewn rock steps, margined by clumps of ferns and a small but noisy waterfall. The main corridor seems particularly dark and cool, none the less so when the eye comes to note the row of tank outlines and sees in their bluish water the chilly movements of trout. The corridor is ring-shaped, its side walls consisting of the faces of large aquaria, nine in the peripheral margin and two in the central, the latter separated by an alleyway in the line of the diameter of the ring. The great height of the tanks is particularly noteworthy; in some

the water measures over twelve feet, giving a depth which results in an enormous pressure upon the glass fronts of the aquaria. This dangerous strain, however, has been cleverly counterbalanced: instead of attempting to employ a large plate of glass to resist the water pressure, the designers have prudently broken the front of the tank into a series of stouter panes, whose outlines are larger above, smaller below, framed massively by log-shaped beams of iron. Rockwork has been largely employed as the background of the aquaria, and the great water depth has favored the use of delicate strings of vertically growing water plants. At present the tanks are almost entirely stocked with fresh-water forms. Adjoining the main corridor has been added a laboratory devoted to experiments in fish culture. Here the hatching troughs are arranged in vertical banks to give the cascadelike waterflow recommended by the earlier culturists.

BERLIN.—Like that of the Trocadero, the Berlin Aquarium, next to be mentioned, ranks among the earliest in Europe, it having been opened, under the directorship of Dr. Brehm, in 1869. From that time onward its success has been remarkable—none the less so that its foundation and management have been due to private enterprise, in the form of a stock company. And to its credit it may safely be said that there has been no other aquarium in Europe which has appealed to a greater number of people and has accomplished its object with greater tact or at the cost of greater efforts.

A visit to the aquarium has come to be one of the interesting sights of Berlin, and the stranger has but little difficulty in finding its tall, stuccoed, buff-colored building at the corner of one of the streets crossing Unter den Linden, although he may feel at first, perhaps, inward qualms at finding the grotto-planned aquarium, of which he has so often heard, incased by a building which differs in no way outwardly from its apartment-house-looking neighbors. He is apt, therefore, to look about him somewhat suspiciously when he discovers that its entrance is strangely theaterlike: there are the box office, the flight of marble steps, the walls over-frescoed with mermaids, the lines of posters, to carry him to its threshold. The serpent gallery is the first to be entered —a long, iron-arched, well-lighted corridor, with glass- or wire-fronted cases on either side. This seems to be intended as the vestibule of the aquarium proper, where the curious visitor can whet his appetite on the sight of tarantulas, land turtles, and lizards before he descends into what seems like the mouth of a huge cavern; for from here onward the walls are of rough stonework, and there are rock-cut steps and darkened stone-arched passageways to lead the visitor from grotto to grotto as he wanders along, gazing at the aquaria on either side. The grotto

which is first entered, however, might best be described as a circular, dome-roofed hall, whose rocky walls are broken by pools and basins to harbor turtles and crocodiles. Here in the middle stands the huge aviary, well stocked with bright-colored birds, and adjoining are the cages of the orang and chimpanzee—non-aquatic attractions, for which, strangely enough, the aquarium has always been noted. From this hall a long, dark gallery, whose walls are pitted with aquaria, leads to a second grotto, domed above, pitlike below, down which the visitor passes to a lower series of corridors which twist and turn, descend and rise, but continue to exhibit aquaria on every side till the exit is reached. Thus have been passed the geological and basalt grottoes and the beaver pool, near which a small descending rill has been made of service for hatching fish eggs. One of the curious features of the aquarium is the idea of distance which impresses the visitor as he wanders on and on; and it is even difficult to convince him that the corridors, grottoes, and twisting passageways can be contained within so small a surface area as that of the residence-looking building he has seen at the corner of the street; and he can not fail to wonder at the ingenuity of the architect, not merely in this regard, but in the arrangement of vistas which occur on every hand, and in the deftness with which the working-day side of the aquarium has been concealed.

Such in brief is the general visitor's idea of the Berlin Aquarium; to the adept its internal organization seems even more ingenious and interesting when it comes to be examined. The tanks are cared for by means of a labyrinth of concealed passageways; the storage reservoir is hidden away below the concrete floor of the lowest gallery, and most remarkable of all is the use of an artificial mixture as an economical substitute for sea water. As long used by Dr. Hermes, the present director, this mixture has been found of great practical value, and it certainly enables many fishes to live in spite of the adverse conditions of their confinement for months and even for years. The variety of living forms which one sees in the various tanks is a striking feature of the aquarium, and one is strongly impressed with the range in marine fauna which is thus kept in a district remote from the sea. The arrangement of the aquaria, it may be further added, is often regional; there will thus be grouped in one tank the forms of the North Sea, in another those of the Mediterranean, in a third those of the Baltic.

BRIGHTON.—A brief description of the Brighton Aquarium must not be omitted, finally, from the present discussion; it is certainly the most typical, if not the largest, of the newer aquariums of Europe. From the architectural standpoint, moreover, its interior must unquestionably be given a foremost rank. Brighton

will be remembered as admirably adapted to the needs of a public aquarium; its position on the shore of the Channel brings it directly in contact with rich fishing grounds, while, as a seaside resort, its closeness to London affords it an unfailing stream of visitors.

The aquarium has been situated in one of the most conspicuous points of the town—the most convenient for aquarial purposes on account of its nearness to the water; the chain bridge is close by, and the two most fashionable driveways, the Madeira Road and the Marine Parade, intersect at its very door posts.

It must be confessed that the exterior of the aquarium is not prepossessing; it suggests the roofed-over foundations of a house; nor is this appearance bettered by the presence of signs and posters. In fact, one is first led to believe that its success is altogether dependent upon the restaurant and small theater which it largely advertises. To enter the aquarium the visitor must descend a long, broad staircase, then pass through an entrance hall and reading room. The main corridor which he thus reaches extends directly in front a distance of four hundred feet; its appearance is, to say the least, an attractive one; it might even be called stately, with its groined arches of brick and terra cotta, and its aisles and row of central columns; it suggests, perhaps, the gallery of an early Italian palace in the shape of its columns and in the height and varied carvings of their capitals. The corridor shows on either side the large, windowlike fronts of the aquaria. These, however, do not appear to be especially brightly lighted; they number in all over fifty, the largest one a hundred feet in length, bending around a space in the central part of the hall. At the present day the stocking of the aquaria is not perhaps as carefully attended to as in earlier years, when the profits of the stockholders were doubtless greater. An effort appears to be made on the part of the management to keep one or two of the small cetaceans, dolphins and porpoises, in the largest tank; and judging from the throng of visitors around the neighboring seals and sea lions, one may reasonably conclude that these pseudo-inhabitants of the aquarium are by no means unpopular. In every season, however, the visitor may find at Brighton an interesting collection of Channel fauna, especially fishes. The general working conditions of the aquarium do not appear widely different from those of Amsterdam.

THE Tibetans whom Mr. St. George R. Littledale met in his journey across their country were men sometimes of strange notions. One of them asked if it was true that there was a big tree near Calcutta, out of the branches of which came all the heat of India; and whether the telescopes of the English party would allow them to see right through the mountains.

ON THE CRATER OF MOUNT SHASTA.

By Prof. A. S. PACKARD.

AT one o'clock on an August morning in 1877 I found myself on the stage bound for Sissons, in Strawberry Valley, a bit of civilization nestled among the pines and redwoods twenty miles from the summit of Mount Shasta. The stage road wound through mountain passes and interminable forests of pines, following up the Sacramento River, here a torrential stream. A turn in the road once gave us a magnificent view of the Shasta cone, rising in a sugar-loaf shape, white as Carrara marble, and seeming to lift itself out of the forest on the right, though it was fifty miles distant.

At Sissons both the cone, which rises to an elevation of 14,440 feet above the Pacific, and its crater to the northwestward, which is about two thousand feet lower, were very distinct. The cone rises about four thousand feet above the timber line, and we could see the rough lava flows and ash fields lying between the summit and the upper edge of the timber belt.

Throughout the woods on the sides of the volcano bears and mountain lions abounded; our driver told me he saw one of the latter walking by the roadside a month previous. We saw deer far up in the woods; antelope range near the summit, and Rocky Mountain sheep, or bighorn, herd in the less accessible cliffs; while some time previous one of that rare and very shy mammal, the Rocky Mountain goat, which inhabits the more inaccessible ranges above the timber line, had been shot.

The view of the mountain that evening by moonlight was very fine. A light, silvery-edged cloud rested on the summit, while the mountain mass below, lighted up by the moonbeams, contrasted with the vast expanse of dark, somber forests in the foreground.

The next day was not favorable for the ascent, but it passed quickly. The forest scenes, enlivened by an encampment of Indians, in the rear of the inn, the rushing mountain torrents, the volcanic cones, or Black Buttes, to the northward, with their lavas, the old moraines, the insect life, all were novel features to an Eastern eye.

It cleared off at sunset; the clouds disappeared, leaving a thin veil of fresh snow on Shasta's peak and crater, now bathed in a ruddy glow, which, as the evening wore on, was replaced by the silvery light of the full-orbed moon.

The 25th was a glorious day, and in the bracing northerly breeze we started on our ride of twenty miles to the camping ground above the timber line. A distance of five or six miles through forests of magnificent oaks, pines, and redwoods brought

us to "The Devil's Garden," which, far from being sulphurous in tone, is a large terminal moraine stretching eight miles west of the crater; the sides slope at a high angle, and the surface, like that of our kames in the Eastern States, is flat and of even width, being a quarter to half a mile wide. It looked at first like a lava stream, but the angular blocks of hornblende andesite intermingled with the *débris* bespoke its glacial origin. On the south of us ran down from the peak high, steep lateral moraines.

Passing above the limit of oak trees, we ascend above the belt of pitch pine and silver pines to the region of firs—speaking botanically, through the belt of *Picea amabilis* and then higher up to *P. nobilis* and *P. contorta*, then to a growth of *P. flexilis*, which attains an elevation of about ten thousand feet. With these, though mostly in the lower belts, were associated the characteristic shrubs of California, the *Manzanita* and *Ceanothus*, also a yellow-flowered, stiff plant like greasewood, which ascends far above the limit of trees. The silver-leafed *P. contorta*, near the upper edge of the timber line, grows from twenty to thirty feet high and from twelve to sixteen inches in diameter, with a very white bark. A zone of firs is situated between it and the highest pines. *P. flexilis* seems to be only a variety of *P. contorta*; it is more or less procumbent, lying down flat, covering yawning chasms or seams in the rough lava, so that one can walk upon the trunks and branches when they bridge the spaces between the angular, jagged blocks of lavas.

Late in the afternoon we selected a level place near a bank of snow at an elevation of about nine thousand five hundred feet, and, gathering a few logs of dead pines, we made a rousing fire, and at nighfall unrolled our heavy California blankets, sleeping nearer the stars than I ever had before. It was a clear, cold night; the water froze nearly an inch thick, and at 6.15 the next morning, when we began our ascent of the crater, the thermometer was 25° F.

We rode our horses for an hour until we came to the foot of the ash cone, and by 8.45 were on the summit of the crater. The view in the clear atmosphere was indeed a wide one. Far to the northwest was the Siskiyou range and Pilate's Knob, and to the west the jagged, saw-toothed, snowy peaks of the Salmon Mountains; fifty miles southward was the snow-clad solitary Lassens Peak, twelve thousand feet high; while Klamath Lakes and the lava beds, the seat of the late Modoc war, lay to the northeastward.

The scene was a wild one within the great crater, whose narrow edge is formed of sharp, jagged peaks and pinnacles. Broad, almost unbroken snow fields extended from the edge down for a thousand feet; at the bottom were two frozen lakes like sheets of

glass. The crater was extinct, no signs of steam or of recent eruptions meeting the eye. We were told that on the summit of the cone there is a hot-steam vent, the last dying embers of past volcanic action. Mr. Sissons, while guiding a traveler to the summit, was once belated and had to spend the night there, and saved the lives of himself and his companion by lying close to the steam vent, the steam passing up through the snow. On their descent they slid down over the snow fields of the summit to the lava beds below.

The outlet of the crater, or point of overflow at the last eruption, was on the western side, where small masses of black obsidian and white incrustations of lime were observed.

Turning away from this wonderful view, we walked over the snow and down the loose rocky sides to a rock overlooking the Whitney Glacier. This ice stream, which stretched uphill past the crater to its source, is about three miles long, and on the north side of the mountain, at a point about 13,500 feet high, it heads in a snow field, or *mer-de-glace*, which is continuous with the head of the McCloud Glacier. Toward the top a large mass of lava projects above the surface of the ice, which is white and very clear near the top; but below this point the glacier is much discolored, more so than any Alpine glacier I have seen. Owing to the steep and uneven pitch of the rocky bed, the surface of the ice, especially near the upper end of the glacier "cascades," or breaks into needles, being rent by numerous crevasses. On each side is a well-marked lateral moraine, with its steepest side next to the overhanging wall of lava; the moraine on the western side begins much lower down. The one on the east side ends in three ridges of dirt and rock, the two uniting to form the great terminal moraine, and, looking far down the glacial stream, this moraine was seen to pass under the ice, or rather the ice overrode it, since the glacier was seen here and there to project above it. Large bowlders or blocks of lava were scattered over it, and its surface was very uneven, with irregular mounds of *débris* and deep pit-holelike hollows or basins between them. The terminal moraine was overlooked by a small volcano or monticule perhaps a thousand feet high, with nine or ten crater cones rising from its sides—a beautiful example, and reminding me, as I remember them, of the monticules on the flanks of Mount Etna.

At and beyond the end of the present terminal moraine stretches away in the distance a number of old moraines, naked and bare as when they were born, forming plains and overlooked by well-wooded hills. A rapid stream with a white bed runs from the end of the glacier in a northerly direction into Shasta Valley, and at night it is not frozen.

On the northeastern side near the end of the glacier are three

well-marked naked old moraines at least two miles in length, which sweep round to the volcano above referred to, and apparently connect with the terminal moraine of a small narrow glacier just east of the Whitney Glacier, and which may formerly have been an upper eastern branch of it. This, perhaps, is the Ash Creek Glacier, which lies on the northeast slope of the mountain, while the McCloud Glacier lies farther to the eastward.

The terminal moraines at the end of the Whitney Glacier, which are not, as in Swiss glaciers, clearly demarked from the end of the glaciers themselves, but form an exceedingly irregular and broken field of rocks and *débris* covering and burying the ice, with many sinks or basins and "kettles," enabled me to clearly understand the mode of formation of the "kettles" or deep holes, at times still filled with water, which are so marked in Massachusetts, near Salem and Marblehead, and also at the "Dumplings" on Canonicut Island near Newport, Rhode Island.

In his account of the McCloud Glacier of Mount Shasta in his entertaining Mountaineering in the Sierra Nevada, Mr. Clarence King states that for "at least a mile's width the whole lower zone is buried under accumulation of morainal matter. Instead of ending like most Swiss glaciers, this ice wastes chiefly in contact with the ground, and when considerable caverns are formed the overlying moraine crushes its way through the rotten roof, making the funnels we had seen."

These immense fields of morainal matter overlying and burying the melting edge of the glacier, here spreading out over the lower flanks of the mountain, were evident signs of the waning of the ice, the glacier having long since ceased to advance; and it enabled me, as never before, to understand that the peculiar hills and basins or kettles of the great terminal moraine of southern New England were formed by the irregular melting of the southern edge of the glacier, when through and under the mass of ice, perhaps not over from three to five hundred feet thick, ran subglacial streams and rivers, while here and there, owing to the uneven melting of the ice, immense masses of gravel and bowlders had fallen in, the material adjoining being rearranged into rounded kames, so characteristic of our New England scenery.

The rocks on the eastern side of the middle portion of the Whitney Glacier were rounded and polished, as much as such hard rock could well be, when the glacier was of greater volume than now. At present the ice has melted away from the sides of the rock overlooking it. So far as I could see from my point of view, the surface was not grooved or striated.

That the glacier was in motion was proved by the not infrequent distant explosions caused by the rupture of the ice near the

head of the glacier. The general appearance of things indicated that the glacier was diminishing in size, and Sissons told me that the surface of the glacier was at least from seventy-five to one hundred feet lower than at the time of his last visit, four years previous.

We lunched on the rim of the crater, at 3 P. M. went down to where we had left our horses, and after a hard and fatiguing though glorious ride of four hours reached the hotel ranch.

We found that the crater cone is composed of a reddish lava, while the mother peak rising far above it is formed of a hard, bluish trachyte. Its moraines extend for ten to twelve miles down the western slope, passing beyond the west side of the stage road north of Sissons, where more or less rounded hillocks of this bluish trachyte abut on the hills of metamorphic rocks of the Trinity and Sacramento Mountains.

We also saw as we descended that the large moraine extending from the cone ending in the "Devil's Garden" is flanked by two lateral moraines, the median one, or the garden, extending from the base of the crater cone. What adds to the singularity and wildness of the scene at the upper end of this "garden," or rather playground of mountain imps, are the numerous parallel concentric ridges of lava rock, forming a succession of transverse terminal moraines, with benches of clear soil between them. These parallel curved rows of stones and angular gravel mark the rapid retreat and melting away of the glacier, which, with its neighbor, extended down on the western slope.

To my disappointment, I found no Alpine fauna or flora on the summit of the crater, and believe there is none on the main peak. The vegetation was very scanty where we camped, only grasses and plants which had straggled up from below, and, so far as I remember, nothing but lichens occurred on the bare rocks and moraines above. No Alpine or arctic butterflies or moths occurred, such as I was familiar with, and which abound on the summits of the Rocky Mountains. A few spiders, a small centipede (*Lithobius*), and a few ants' nests were to be seen, and under stones a bristle-tail (*Machilis*), but the only distinctive Alpine insect on the mountain was a wingless grasshopper (*Pezotettix*), though that occurred lower down, in the zone of firs. I saw a common *Pieris* butterfly at the top of the crater, but this was like one seen flying below.

This entire lack of any Alpine plants or animals indicates that Mount Shasta is too young and isolated a mountain to have been reached by any waifs from arctic or Alpine sources, and their absence suggests that the glaciers had at a very recent date melted away and disappeared from the western side of the mountain.

But that the whole *massif* or mountain mass had once been enshrouded by the ice of a late glacial epoch was proved by the existence among the farms of Strawberry Valley, some ten miles in a direct line from the summit, of two well-rounded hills or flattened domes of a supposed metamorphic rock which had evidently been regularly molded by ice.

This was further proved to our own satisfaction the next day after our descent, in riding on the stage from Berryvale to Butteville. Directly beyond the hotel is a remarkable terminal moraine evidently derived from the crater, as it is composed of small bowlders of reddish-brown lava; these are arranged in transverse, curved parallel rows on the plain, with clear grass-grown spaces between them, much as in the larger, higher ones in the "Devil's Garden" moraine, but the bowlders are very much smaller and less angular. This point is about twenty-five hundred feet above the sea, and about fifteen or twenty miles from the summit of the crater. Hence the ice seems to have extended from the snow fields of Shasta's summit down upon the plains, where it apparently abutted on the Trinity and Sacramento ranges, which were probably below the ice belt and not glaciated.

From Butteville the view of Mount Shasta is incomparably fine—one of the world's great views. Looking from this point, the cone is in line with the mother peak. The great cone or mountain mass rises as a unit from a broad, treeless plain dotted with scattered ranches and pierces the clouds. Above this plain, as the afternoon waned and the evening shades fell, the zone of black firs and pines merged into a region of dark purple, becoming more ruddy above, until the last beams of the setting sun tinged and flushed the snowy summit with an Alpine glow. As these pink and reddish tints faded away, the dark purple mass of color rose higher and higher until the darker shades of evening completely enshrouded it, and finally as the darkness fell the cone lost its height and distinctness.

No one knows when the oil fields of Yenangyaung in Burmah were first discovered; but the legend of their origin relates that in January, 1099, a king of Pagau, attracted by the accounts he had heard of the marvels of the region, especially of a wonderful spring of sweet-scented waters, visited the spot. Some of his courtiers who also visited the spring were so entranced by the exquisite odors exhaled from it that they forgot to return at night. The king, searching for them the next morning, found them thus enthralled, to the neglect of the duties they owed him, and in his anger ordered their immediate execution; while, exercising his miraculous powers, he changed the sweet odors to the repulsive smell of petroleum. From this the place came to be known by its present name, which means Stinking-water Creek.

NOTES ON BHILS, BURMESE, AND BATTAKS.

By Dr. R. W. SHUFELDT.

ABOUT a year ago the distinguished anthropologist of the University of Zürich, Dr. Rudolph Martin, presented the writer with a small but very valuable collection of photographs of certain peoples of India and the East Indies. Some of these are very rare, and, upon searching the ethnological works in the Government libraries in Washington, I have been unable to find examples of quite a number of them.

For instance, we have scarcely any literature upon the history of that truly interesting race of Indian peoples known as the Bhils. Two of my photographs (Figs. 1 and 2) are devoted to a Bhil beauty, the one giving her directly *en face*, and the other *en profile*. This is the true scientific method of photographing a subject of this kind, and it has been my experience among native races that it can usually be done. It practically very much enhances the value of either picture; for characters and objects of dress and ornament, seen upon front view, can often be only fully explained by the one taken upon lateral aspect, and *vice versa*.

Fig. 1.—A Bhil Beauty, India. Seen upon front view.

In this Bhil woman, for example, the central fastening of the chain ornament at the fore end of the hair-parting is distinctly seen when we regard her from in front, whereas the very peculiar perforated, circular ornament of metal in the wing of the nose is but partly made out. Taken upon side view, these conditions are exactly reversed, and with a lens of moderate power one can easily study in detail the several interesting ornaments with which she has bedecked her head and neck. Upon profile, too, we can appreciate the nature of her headdress behind, which is quite out of the question when the subject, in this case, is seen from in front. This is likewise the only method

by means of which we can properly study the features of the individual whom we have photographed, and learn something of the facial angle and similar characters. It will be noted that this Bhil beauty wears as many as half a dozen heavy metal bracelets upon either wrist, and the collection of trinkets that hang over her ears is extremely curious. Her rather light attire permits us to form some opinion as to the physique of this woman, and it is not difficult to see that in such particulars she is remarkably well proportioned. She is evidently broad and deep-chested; has finely developed limbs, and a well-balanced head, upon rather square shoulders. The form of her face is nearly circular, with large mouth and nose, and the eyes are set far apart. Her complexion is dark, and she is somewhat small in stature. Bhils have the reputation of being very active and capable of enduring much fatigue with impunity. Twenty years ago, or less perhaps, this tribe occupied a British political agency—the Bhil agency, in central Asia—which covered an area of some eighty-one hundred and sixty square miles, and had a population of nearly a quarter of a million of people. This agency was established in 1825, at which time a Bhil corps was organized "with a view to utilizing the warlike instincts of the Bhil tribes. This brave body of men have done good service, and gradually put down the predatory habits of their countrymen. The Bhil tribes chiefly inhabit the rocky ranges of the Vindhya and Sátpurá Mountains, and the banks of the Narbadá and the Tapti. In common with other hill tribes, the Bhils are supposed to have been aborigines of India, and to have been driven to their present fastnesses at the time of the Hindu invasion."

FIG. 2.—A BHIL BEAUTY, INDIA. Photographed *en profile*. Same subject as shown in Fig. 1.

I understand that numerous efforts have been made to break up their plundering ways by the home Government, and that the official reports stated in 1869–'70 that "the Bhils of Mánpur are becoming reconciled to the life of cultivators, though not yet

willing to take out leases." How this may be at the present date the writer is not informed.

Dr. Hunter, when Director-General of Statistics to the Government of India, wrote, in reference to the Scythic and non-Aryan influence in that country, that "proceeding inward to the Northwestern Provinces, we find traces of an early Buddhist civilization having been overturned by rude non-Aryan races. In Bareilly district, for example, the wild Ahírs from the north, the Bhils from the south, and the Bhars from the west seem to have expelled highly developed Aryan communities not long before 1000 A. D." Not a few works upon these Indian tribes have appeared in England, as well as elsewhere, and doubtless much more remains to be said about these wonderfully interesting people, that will prove to be of great importance to the science of ethnology.

A very different appearing people from the Bhils are the natives of Burmah, for in the Burmese we have the characteristics of the Mongoloid types, possessed in common with all the races of Indo-China, including those of the tribes of Tibet and the eastern extremities of the Himalayan range of mountains. As a rule, they possess a fine physique, and, as in the case of the Bhils, they, too, are notoriously active and hardy. In complexion they are usually dark, but never very decidedly so, the common shade of the skin being of a warm, rich brown. Burmans of the typical stock have black hair, that is rather coarse and very abundant, being straight as in the case of the Chinese. Some of the men are pretty well bearded, more distinctly so, indeed, than are their not distant neighbors the natives of Siam. The word "Burma" or "Burmah" is derived from their own name of their race, which is Mran-má, being pronounced Ba-má, in distinct monosyllabic tone, as their language usually is. In this respect it resembles the dialects of southern China, while in other particulars it exhibits evident Tibetan relations. Soft and flexible almost to a fault, the language of these people is written in letters of a subcircular form in most cases, and for nearly seven centu-

FIG. 3.—A BURMESE MOTHER AND HER CHILD. From a photograph.

ries it has been the medium of recording their very interesting literature. Its alphabet is said to be of Indian origin, and was ushered in with the religion of Buddha. Burmese are not behindhand in the matter of some manufactures, though they are by no means up to the better races of India in these particulars. Upon crudely constructed looms, their women make a cloth of a very good quality, such as is worn by the child and its mother shown in Fig. 3. Gorgeous silk cloths, made from Chinese silk, are woven in other localities, and patterns of flowers are frequently embroidered (see Fig. 3). They also use numerous fabrics which they obtain through the medium of trade with the British, who have already conquered a considerable part of the Empire of Burma. As is the case with so many other peoples of the East, the women are fond of personal adornment. They wear from five to six bracelets around their wrists, a multiplicity of necklaces, and very frequently circular, worked ear ornaments of silver or gold on the lobes of the ears. In Fig. 3 the woman is smoking a large cigar. An authority at my hand says the Burmese are passionately fond of the drama, "which appears under the various forms of masquerades, puppet shows, ballet opera, and farces, as well as in the more dignified character of the regular tragedy. The moral character of the plays is often of the lowest kind, the utmost license both of speech and action being allowed on the stage. The scenery is of a very simple and purely suggestive kind, a single branch of a tree standing for a forest, and frequently the filling up of the dialogue is largely left to the ingenuity of the actors, little more than hints of the plot being contained in many of the librettos. The popular interest in the dramatic exhibitions is intense, and, as in Siam, the same piece often drags its slow length along for days together." Some of the young Burmese women have very intelligent features, and are far from being unprepossessing. The young girl shown in Fig. 4 is of this class, and it is seen that she

FIG. 4.—A YOUNG BURMESE BEAUTY.
From a photograph.

is endowed with a style of Oriental beauty by no means unattractive or to be despised. Their despotic king never allows any of his subjects to quit the country without his permission, and least of all, women. The British and others living in Burmah have not always had their eyes closed to the charms of the Burmese girls, and when they have had children by them they have experienced difficulties of the most extraordinary nature upon leaving the land in their attempts to take these and their mothers with them. Often fabulous fees have had to be paid to effect their removal. They are remarkably faithful to their masters, being affectionate, industrious, and extremely domestic. Those having these habits despise prostitution, for a prostitute among them is an outcast, while they in their own calling are not dishonored. In contrast with other parts of the East, the women of Burmah go about openly, and are not excluded from the sight of the men. They also have not a little to say in the community, even being able, with the proof of cruel treatment, to plead in court for a divorce, and this last, under such circumstances, is usually obtained without difficulty.

Leaving India now, and passing to the island of Sumatra, I desire to introduce an entirely different race of people; these are the Battaks,* and they are of great interest to the anthropologist from any point he may choose to consider them. Many books and descriptions have appeared about the Battaks, dating back before the middle of the present century. One writer tells us that it "is not known whether they were settled in Sumatra before the Hindu period. Their language contains words of Sanskrit origin, and others most readily referred to Javanese, Malay, Menangkabau, Macassar, Sundanese, Niasese, and Tagal influence." In 1866, when Prof. Albert S. Bickmore was traveling in Sumatra, he saw not a little of these people, and he believed then that the place where their aboriginal civilization sprang up was very likely on the shores of that famous Sumatran lake, Lake Toba, and upon the neighboring plateau of Silindong. From this locality they gradually occupied an extensive domain in the interior, which was extended upon either side to the seacoast. Eventually, however, the Malays spread along the coast line, and thus confined the Battaks once more to the interior.

Nearly twenty years later, Webster wrote that they occupied the country only to the southeast of Achin, the territory in the middle of which Lake Toba is situated. From all that I can gather upon the subject at the present time, it would appear that this curious race, although they are distinctly different from the typical Malay, these last-named people, together with the Achin

* This word is also spelled "Batah" and "Batta."

population, are rapidly absorbing them. Webster, in describing the Battaks, says: "The average stature of the men is about five feet four inches; of the women, four feet eight inches. In general build they are rather thickset, with broad shoulders and fairly muscular limbs. The color of the skin ranges from dark brown to a yellowish tint, the darkness apparently quite independent of climatic influences or distinction of race. The skull is rather oval than round. In marked contrast to the Malay type are the large, black, long-shaped eyes, beneath heavy black or

FIG. 5.—A GROUP OF BATTAKS.

dark-brown eyebrows. The cheek bones are somewhat prominent, but less so than among the Malays."

Neuman, in 1886, reckoned the population of the entire river basin occupied by the Battaks at fifty thousand, and Van der Tunk has given us a very good account of their language, and of the Toba dialect in particular. Battak poetry has been treated by Mr. C. A. Ophnijen in a very entertaining volume, and in it he describes "a curious leaf language used by Battak lovers, in which the name of some leaf or plant is substituted for the word with which it has greatest phonetic similarity."

The Battaks have invented an alphabetic language of their own, and the various shaped letters are sometimes quite intricate and difficult to decipher. Often they write it on narrow strips of tender bamboo about half a foot long, using for the purpose the

point of a blunt needle. Their dialects differ but little in degree, and consequently the unification of their language is quite complete. Many of their superstitions, their myths, and their beliefs are most interesting, and when one comes to consider their advancement in certain directions it is certainly very remarkable, as Bickmore remarks, that "all of them, beyond the territory under the Dutch Government, are *cannibals*. Those living on this plain also feasted on human flesh until the Dutch conquered

FIG. 6.—BATTAK GIRLS. From a photograph.

them, and obliged them to give up such fiendish custom. The Rajah of Sipirok assured the Governor of Padang that he had eaten human flesh between thirty and forty times, and that he had never in all his life tasted anything that he relished half as well. This custom has prevailed among the Battas from time immemorial."

Marco Polo claims that the Battaks have been cannibals for a time extending at least as far back as the year 1290; and Sir Stamford Raffles, who was among them in 1820, found some of their laws to be very severe. For crimes for which we give but

light penalties, or a few years in jail, the Battaks cut up their perpetrators alive, and I dare say ate them afterward; indeed, cases are on record where a Battak has been convicted of adultery, and his discoverers, members of his own tribe, have cut him up alive and then feasted upon his remains. A missionary once told Prof. Bickmore that he knew of a Battak who "had been guilty of stealing an article of only very little value according to their ideas of wealth, yet he was seized, his arms extended at full length and fastened to a bamboo, a sharpened prop placed under his chin, so that he could not move his head, and in this condition he was bound fast to a tree. The knife was then handed to the native who had lost the article, and he was ordered to step forward and cut out of the living man what piece he preferred. This he did promptly; the rajah took the second choice, and then the people finished the cold-blooded butchery, and thus their victim died.

"The parts that are esteemed the greatest delicacies are the palms of the hands, and after them the eyes. As soon as a piece is cut out it is dipped, still warm and steaming, in *sambal*, a common condiment, composed of red or Chili peppers and a few grains of coarse salt, ground up between two flat stones. Formerly it appears to have been the custom to broil the human flesh, for Mr. Marsden states that in December, 1780, a native of Nias, who stabbed a Batta at Batang Taroh, the river I crossed on the suspension bridge, was seized at six one morning, and, without any judicial process, was tied to a stake, cut in pieces with the utmost eagerness while yet alive, and eaten upon the spot, partly *broiled*, but mostly raw."

Such are some of the characters and habits of the people shown in Figs. 5 and 6 accompanying the present article. It will be seen that the members composing the group shown in Fig. 5 are but scantily clad, and they are each and all almost completely devoid of any ornament. The three elder boys wear turbanlike affairs upon their heads, while the old woman at the right-hand end of the line in the rear row has a peculiar kind of a headdress on. I have very carefully studied the faces of these individuals, and I am free to confess that, judging from their features, they seem to be capable of committing almost any species of barbarity.

The two girls shown in Fig. 6 are particularly interesting, especially the one sitting down, whom I understand the Battaks consider to be a great beauty. The one standing up, with the big earrings in her ears, has as veritable a face of a savage as I ever remember having seen anywhere. As in the case with the boys shown in Fig. 5, these girls likewise wear headdresses, but of somewhat though not a very different style. They, too, are but lightly attired, and possess the same set and wicked expression in their eyes. Yet, and notwithstanding this, and taking into con-

sideration what I know of these two Battak girls, I must say I have not infrequently met with types of negroes, both in the South as well as in Washington, that possessed features nearly the counterpart of these Battaks. In this connection we must remember, however, that the negroes in this country need not trace back so very far before their arrival at an ancestral stock that can hardly be considered above suspicion in the matter of cannibalism, and that, too, without having been the inventors of an alphabet and a written language to redeem the fact.

THE ABUNDANCE OF ANIMAL LIFE.

By M. ALBERT GAUDRY.

WE find in studying the past epochs of the earth's history that they have been marked by an abundance of life, even exceeding any which prevails in the present. Comparing the existing state with the past, we are struck with the immensity of the part played by the inferior organisms. Life is everywhere; the number of microbes is infinite. Rocks which at first seem to belong only to the domain of mineralogy are found to appertain very largely to that of biology. One of the grandest spectacles, for example, is offered by the travertines of the Mammoth Hot Springs, in the Rocky Mountain National Park, which Mr. Weed declares are formed chiefly through the agency of algæ, withdrawing the excess of carbonic acid from the water, and forcing the precipitation of the limestone. Going from the hot springs to the geysers, we find deposits of silica which have been formed in the same way; and what is called gelatinous silica is largely vegetable matter. The lower animals are also so numerous in some places that they contribute to the formation of rocks. Plancus has calculated that three grammes of certain sands of the Caribbean Sea contain 180,000 shells of foraminifera. M. Schlumberger found 116,000 foraminifera shells in a cubic centimetre of the Atlantic mud which was brought up by the Travailleur expedition. Polyps construct atolls, barrier reefs, and islands; and if the bottoms of the oceans were uncovered we should doubtless see coralline rocks no less extended than the Secondary formation called the coral rag. It is said that the shells of the *Etheria* form such large beds in the Senegal that they are quarried to be made into lime, and that on the shores of Lake Pontchartrain, near New Orleans, the *Gnathodons* form a bed four miles and a half long, nearly two hundred feet wide, and sixteen feet thick. I have been informed by M. Sauvage, to whom we owe many important works on marine animals, that the year's crop of oysters as entered in the

statistical tables of the Minister of the Marine reaches the prodigious figure of 1,407,390,400. In the same year there were returned 1,262,600 bushels of mussels and 620,000 bushels of other shellfish than oysters and mussels. The same authority estimates that 2,200,000 lobsters, 16,000,000,000 shrimps and prawns, 1,080,000,000 sardines, and 400,000,000 herrings are consumed in France in a single year. The cod, the mackerel, and the fresh fishes would also represent considerable quantities. The fishermen of the single port of Boulogne took 63,000,000 kilogrammes of fish during a period of nine years. Assuredly the statistics of such other countries as Great Britain, Norway, and Newfoundland would give not less considerable figures. These numbers illustrate the richness of the life that is concealed under the waves of existing seas.

Although the reptiles are much less various in our epoch than during the Secondary age, they are still numerous in some regions. According to Alcide d'Orbigny, caymans are numbered by thousands in the province of Moxos. The traveler Leguat, speaking of the extinct tortoises of the island of Rodriguez in 1708, wrote that they were seen sometimes in troops of two or three thousand, so that one could go more than two hundred paces on their backs without putting his foot on the ground. M. A. Milne-Edwards found reports in the office of the ministry according to which thirty thousand tortoises were taken from Rodriguez in a year and a half to supply Mauritius and Réunion. Venomous serpents are so common in India that M. Sauvage says that in comparison with them tigers and panthers are inoffensive beasts. According to official documents, more than nineteen thousand persons perished in India in one ye .r from snake bites.

Warm-blooded animals have especially multiplied in our epoch. Livingstone met in the country of the Makololos more than thirty different species of birds; among them hundreds of ibis, files of three hundred pelicans, myriads of ducks, many geese, herons, kalas, crossbills, burgills, spoonbills, and flamingoes, and an enormous multitude of gulls and cranes. Delegorgue has also executed paintings showing the abundance of the birds. He speaks of having seen five hundred or a thousand vultures upon a single elephant's carcass. Nothing, he says, is more s range to the hunter than to see rising at his approach, circling in the air, that mass of feathered creatures which forms a kind of immense movable dais above him. Alcide d'Orbigny, in his travels in Bolivia, descending the Mamoré, found its banks animated with innumerable shore birds. The tantalus, in troops of several thousands, marched with slow steps upon the muddy parts in company with the red spoonbill or white egret, while the sand banks were covered with scissorbills and sea swallows, together with many goatsuckers. In the country of the Chiquitos, D'Orbigny met cardinal

and cacique birds which "possessed the qualities rarely found together, of melodious song and brilliant plumage. Toucans made the woods resonant with their sharp accents, which were mingled with the disagreeable cries of paroquets of numerous species and of red and yellow aras. . . . The woods resounded with the cadenced cries of the penelope and the hoecos; by means of his cry at a fixed hour the kamichi serves the Indians instead of a clock."

The abundance of mammals is still more extraordinary than that of birds. Livingstone speaks of a band of more than ten thousand euchoris antelopes. Delegorgue says, describing a meeting he had with these animals: "The dust flew and formed thick clouds in a hundred directions. Sometimes it rose in whirling columns to the height of one hundred or two hundred feet. . . . Immediately I perceived the innumerable troops of springboks which were raising these clouds. . . . The vision astonished me so that I had to question myself in order to be sure that it was not a vision. There were bands of from three to ten thousand individuals each, crossing one another's course at all points at once." The same traveler speaks also of large herds of gnus and elands; and he speaks of bands of a thousand or fifteen hundred buffaloes.

Allen, in his admirable work on the bisons of America, gives some curious details on the importance their herds once had and on their extinction. The 2,500,000 bisons that were killed between 1870 and 1875 would represent 50,000,000 in a century.

The solipedes abound in our epoch. Delegorgue saw bands of four or five hundred quaggas in Africa. Mr. Blanford says that Dr. Aitchison met a troop of one thousand herniones in Afghanistan. Brehm estimates, following Youatt, that the number of horses in all Russia is near 20,000,000 head. The rapidity with which horses left loose multiply in America is well known. Wild elephants are destined to be annihilated by man, but they are still numerous in some regions. Speke relates that when he was on the banks of the Nile, he found himself in the midst of a drove of several hundred elephants. Delegorgue estimates the number of elephants which he saw on a space about ten thousand feet in diameter in the Amazulu country at six hundred.

The rodents have a surprising force of propagation and multiply with the most astonishing rapidity. In 1863 a Mr. Austin took some rabbits to Australia for stocking his hunting grounds. The introduction of them was a disaster. They have so multiplied that thousands and thousands of acres of land have been ravaged, and thousands of men ruined. According to a report made three years ago, there are 20,000,000 rabbits in southern Victoria and northern Queensland. Brehm relates that 1,500,000 of field mice (*Arvicola arvalis*) were destroyed in fifteen days in the canton of Saverne, and that a factory in Breslau having offered a centime

(a quarter of a cent) a dozen for these animals, some peasants delivered fourteen hundred of them a day. Charles Martens has given some curious details concerning the immense troop of lemmings (*Myodes*) in Norway. I was struck with the multitude of squirrels in the Rocky Mountains. We met them at every step in passing through the wooded regions. Alcide d'Orbigny relates that when at Carmen de Moxos he was nearly suffocated by the odor of musk in his house. It came from the thousands of bats that hung from the roof during the day. Marine mammals were also very numerous before they were pursued by man. Buffon says that in 1704 the crew of an English ship met a school of more than a thousand morses near Cherry Island, in latitude 75°.

Notwithstanding the number of beings that disappeared in the various geological epochs, I believe that the sum of the appearances surpassed that of the extinctions till the end of the Miocene. I can not assert that there has not been some diminution since that period; but we can affirm that a prodigious fecundity prevails at the present time.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE Cambodian doctors, according to M. Paul d'Enjoy, largely use vegetable poisons as medicines, and apply them with very great skill; and they are often possessors of recipes, the secret of which is carefully kept within the family. They pretend to be acquainted with the love philter, and sell at a very high price a colorless oil with which the young men impregnate their lips in hopes of winning the young women through its magical power. The Cambodian bonzes have established in the vicinity of their monasteries, and the Annamites near their pagodas and under their own direction, refuges where the sick are taken care of gratuitously. The institutions are sustained by public charity and by the generous gifts of patients. Many of the wealthy are not ashamed to have themselves taken to these asylums, hoping that their cure may be made more complete through the protection of the ministers of God, under whose care they place themselves.

INSECT chrysalides seem totally inert, and to the ordinary observer suggest a mummy rather than anything else. Yet, when occasion arises, they are able to manifest their vitality and even to be active. M. G. de Rocquigny Adanson, studying some Saturnias, opened a few of the cocoons, and having examined the insects, put them in a box in which the place of their broken silken envelope was supplied by cotton wadding. Three weeks afterward he found that they had changed position, and, examining them more closely, that they had thrown out threads and fastened themselves to the cotton. Madame Elisée Reclus, studying natural history in Switzerland, had some Vanessas much shaken by the jolts in descending the mountain, and afterward more shaken on the railway train. Observing them after they had enjoyed a few hours of quiet at home, she found that they had changed position, and, having thrown out threads and cross threads, had fastened themselves firmly to the lid of the box in which they were kept.

SHELLS.

By MARGARET WENTWORTH LEIGHTON.

See what a lovely shell,
Small and pure as a pearl,
Lying close to my foot,
Frail, but a work divine,
Made so fairly well
With delicate spire and whorl,
How exquisitely minute,
A miracle of design!

Slight, to be crushed with a tap
Of my finger nail on the sand;
Small, but a work divine;
Frail, but of force to withstand,
Year upon year, the shock
Of cataract seas that snap
The three-decker's oaken spine
Athwart the ledges of rock
Here on the Breton strand!

—TENNYSON.

AS we watch the little pools of water left among the rocks by the retreating tide the pearly luster or the violet or golden tint of some tiny shell catches our eye. How exquisite its form and coloring!

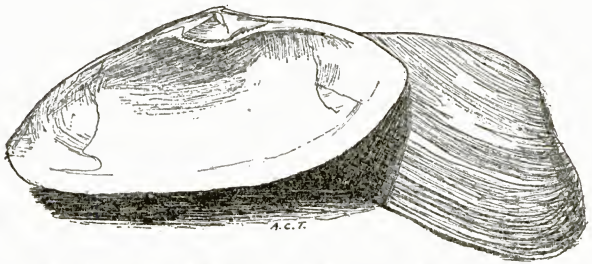
Shells have always, from the most ancient times, been greatly prized. Prehistoric men discovered in the burial caves of Auvergne have chaplets of shells which scientific men tell us they must have traveled long distances to gather. It is only of late years that their curious little occupants have been interviewed and some ideas obtained with regard to their characteristics and mode of living.

All shells with their inhabitants belong to the immense class known as *Mollusca*, or soft-footed animals. Shells are divided into two groups—univalve, those having but one valve, as the snail, whelks, cowries, etc.; and bivalve, as the oyster, clam, and mussel.

If we take the clam as a typical mollusk we shall see that each little line on the inside or outside of the shell reveals an interesting fact. On the outer surface of each valve are a number of concentric lines parallel to the edge and growing fainter toward the hinge part. These are called the lines of growth, and are made by the mantle. The clam's mantle is quite as useful to him as are our hands to us, and he uses it for similar purposes. The mantle surrounds the clam's body inside the shell, its edge pro-

truding and looking like a row of little frills. This edge secretes carbonate of lime from the water and adds it to the shell all along the outer edge, forming a new line of growth. Thus, as the clam increases in size his house grows proportionately, so that it always exactly fits him. The two halves of the shell are joined by a curious hinge. In some kinds of shells the hinge is external and in some internal. It consists of teeth (two or more) with spaces between on either half. These lock together, and are held by a strong, elastic muscle. On the inside of the clam shell are two slight depressions, where the powerful adductor muscles of the body were fastened.

The clam's body is completely enshrouded in the mantle, except for two openings, through one of which the foot can be



CLAM SHELL. Exterior showing lines of growth; interior showing muscle scars.

pushed out. The other is for the siphon, or what is commonly known as the "neck" of the clam. In some respects the clam may be better off than we are, for he has a little brain in his foot and also a gland for secreting strong fibers. With this he spins a byssus by which he can attach himself to whatever he likes. He does not even have to search for his food, but waits for it to come to him. He makes a burrow in the mud or sand, attaching himself to the bottom by the byssus. Then he thrusts his siphon up through the mud and water until it reaches the surface. The siphon is made up of two tubes, the water flowing in through one and out through the other.

When the inflowing current, laden with minute plants and animals, reaches the gill chamber, some of these are sifted out and retained for food, while the water and waste matter flow out through the other tube.

The clam's eggs are carried by the mother on her gills. When there are fish in the water with them the mother clams discharge the eggs, which soon hatch, but if there are no fish they carry the eggs until they decay. The reason of this strange behavior is

this: When the eggs are set free in the water they soon hatch, and the little ones swim about until they find some fish to which to attach themselves. They live for a time on the mucus of the fish and then drop off, sink to the bottom, and form burrows for themselves. This curious semiparasitic life is no doubt a reversion to the habit of some ancient ancestor.

The white-shelled clams live in sand, the black-shelled in mud. Besides living on the seacoast, clams inhabit all United States fresh waters, and in some New York and Western rivers clams have been found which contained pearls of great beauty and considerable value. I have never seen anything more exquisite than the pink pearl lining of some river clam shells.

The razor shell, familiar to all on account of its universal distribution, belongs to the clam family. It has a powerful foot, with which it can scoop out a passage through the sand faster than a man can dig with his spade. One of the clams inhabiting warm inlets south of Boston is the quahog. The shells have a finely beaded edge and are partly lined with deep violet. It was from this that the New England Indians made their purple "wampum" (money), which was considered twice as valuable as the white "wampum." The old-time spelling of clam, *clamp*, was characteristic of one of its chief features, the two halves being so tightly clamped together.

The oyster, a close relation of the clam, is perhaps the most useful and valuable member of all the molluscan group to mankind. The left half of the shell is generally attached to some submerged object and is quite hollow, for it is in this half that the body lies, the upper or right half being almost flat. The oyster readily adapts its shell to surrounding objects, growing about them in most fantastic ways.

When a grain of sand or any minute particle gets in between the oyster's mantle and the shell it is very irritating, and causes a great excretion of matter to take place. This collects around the nucleus in concentric coats like those of an onion. If the lining of the shell be mother-of-pearl, these coats of matter which cover the little grain of sand will also be pearly, and perhaps form a gem of priceless value. Sometimes one of the oyster's own eggs lodges between mantle and shell and is transformed into a wonderful tear of rainbow hues. It is only those shells having a pearly or nacreous lining which can form these gems. For hundreds of years pearl fishing has been a lucrative industry. The most renowned fisheries are at Panama, Ceylon, and in the Red Sea. The pearl oysters are very large, live in from six to twelve fathoms of water, and are gathered by diving.

Pliny calls the scallops (*Pectinidæ*) butterflies of the sea. They are very shy and live in the midst of the eel grass, where the

water is warm. The shells range in color from pure white, through all shades of yellow, to bright orange, and some are exquisitely banded and shaded with light and dark brown. The edge of the mantle is fringed with long and short tentacles, among which are thirty silver-blue eyes. As they are not as highly organized as our eyes, *Pecten* needs a much larger number of them. The scallops, unlike most of the mollusks, can swim through the water

RAZOR SHELL (*Ensis americana*).

by rapidly opening and shutting the valves. Closing them suddenly drives out the water in a powerful jet, which by reaction sends the shell forward. It must be a strange and beautiful sight to see a flock of these "butterflies" flying through the blue water on a fair summer day. Scallops used to be known in Europe as pilgrim shells, because they were used by the pilgrims of the middle ages as a badge.

A most remarkable family of shellfish are the piddocks, living in England, America, and Borneo. They are all borers. The shells of those which inhabit the English chalk cliffs are snow-white, to match their home. Some bore in rock, some in the red chalk, and the most wonderful of all, the East Indian species, lives in the trunks of dead trees. Their shells are covered with deep grooves crossing each other and forming a sort of rasp. The foot, which is covered with a hard dermal armor, is pressed against the sides and the shell turned about, thus easily scooping out a cavity in the soft chalk. The piddock continually floods his burrow with water to wash out the particles of chalk that collect as he works. The piddock has a little light of its own, so that it could travel safely about after dark were it necessary. This is a peculiarity of many of the creatures of the sea, and often on a summer night in the tropics the water is ablaze with their phosphorescence.

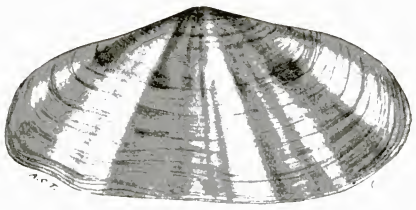
Mussels, living in both salt and fresh water, form a large class of mollusks. Some of them can climb about on the rocks by throwing out a byssus thread, pulling themselves up, then fastening another above that, and so on.

The horse mussel is one of the largest, and very interesting on account of a boarder which it often entertains. A tiny crustacean, the pea crab, lives inside its shell in peace and happiness. The crab is not a parasite, as it does not live on the mussel itself, but merely a messmate eating the refuse of its food.

The Noah's ark is a most oddly shaped shell, and was named by Linnæus from its resemblance to that primitive craft. One ark found in the Mediterranean sometimes contains violet-colored pearls, and one on our coasts is called the "bloody clam," from its fiery gills and the crimson fluid in its tissues. Some of the arks live in submerged clefts of the rocks, and are so busy eating and growing that before they know it they have grown too large to get out, and must remain prisoners for the rest of their lives.

The teredo, or ship worm, would hardly seem to belong with this group of animals, but it is a true bivalve, having a pair of tiny shells at one end of its wormlike body. It has been a most terrible pest ever since men began to traverse the ocean, for its favorite home is the bottom of a wooden ship. It belongs to a family of borers. Some bore in coral, some in rock, and others in wood. The baby teredo, when floating about in the water, comes across a vessel or piece of wood, and immediately begins to bore into it with the edges of a pair of pallets which it has for the purpose. As it proceeds, a calcareous lining is formed to the burrow, which increases in size as the teredo grows. It never leaves its hole again during life.

One very curious fact connected with the teredo is that the burrow of one never runs into nor crosses the burrow of another, even though the wood between is no thicker than a sheet of paper. These little fellows work very rapidly, as the following item from Quatrefages will show: A ship was sunk near St. Sebastian, Spain, and in four months, when it was raised, all the timbers and planks were so riddled with teredo burrows that they were entirely worthless.

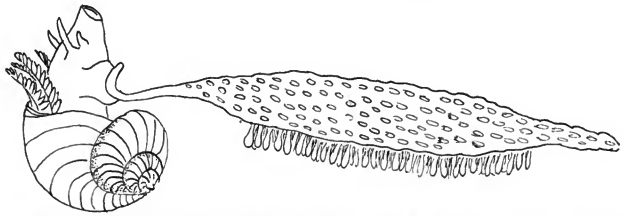


Sunset Shell.

The most brilliant and withal attractive shells in my collection are from the West Indies. I call them sunset shells, because they look as the sky often does on a beautiful summer evening. They are somewhat like clam shells in shape, but narrower and flatter, and most delicately finished. Some are flushed with delicate pink, with rays of pale yellow, others are violet and white, still others green. All the colors of the rainbow are here blended and harmonized with the matchless perfection with which the Great Artist works.

The univalves are more highly developed than the bivalves. They are called *Gasteropods*, which means stomach-footed, be-

cause they have a long foot lying the whole length of the body. Unlike the bivalves, they have a distinct head, in which the brain is situated. Often there are tentacles or feelers, as in the snail, on the ends of which the eyes are placed. *Gasteropods* have a wonderful eating apparatus called the *odontophore* or tooth ribbon. It is covered with hooked teeth, pointing backward, and is in the lower side of the mouth, situated about the same as our tongues. On the upper side of the mouth is a hard plate or jaw, and the food is ground up by the toothed ribbon against this plate. The



VIOLET SNAIL AND EGG FLOAT (*Ianthina fragilis*). Copied from the Riverside Natural History by kind permission of Houghton, Mifflin & Co.

odontophore wears out rapidly, but as the front part is used up it grows from behind, and these animals are so fortunate as to have a new set of teeth every little while.

There is only one shell to take the place of two in the bivalves, so most of the univalves have an operculum. This is a little lid (either horny or calcareous) on the upper side of the foot which exactly fits the aperture in the shell. If a *Gasteropod* wishes for any reason to be alone and rest for a time, he only has to draw in his foot, pull to the door, and he is in complete seclusion from all the world.

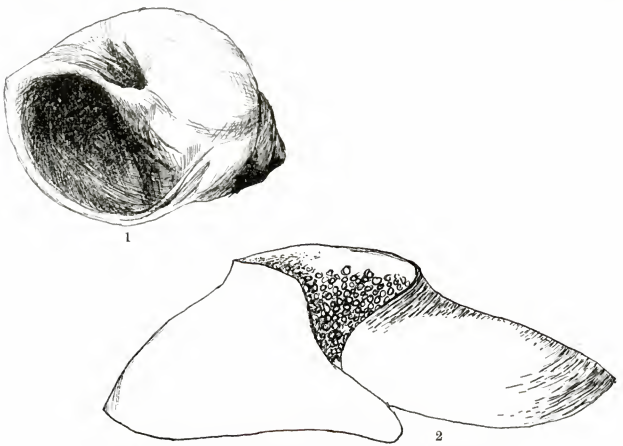
The shells of the *Gasteropods*, like those of the bivalves, are often covered with a sort of horny membrane or epidermis which protects them from the eroding power of the water and other external injuries.

At the bottom of the *Gasteropod* group is a wonderful creature which we may call a multivalve, as its shell is made up of a number of plates (usually eight) which look like ancient armor. It is called the mail shell, or *chiton*, and is the only example in the world of a shell composed of more than two parts. It is common on the Atlantic coast, in some of the bays and inlets south of Boston, on the Pacific shores, in England, and other places. Chitons sometimes have as many as eight thousand eyes, their backs being covered with them.

The limpets range in shape from those which are almost flat to a perfect cone. Some of my prettiest from Sitka are snow-

white, and look like little peaked nightcaps. One is the cup-and-saucer limpet, and indeed it might easily serve as such on the table of some water sprite. It is glistening brown in color and looks like porcelain. The slipper limpets or boat shells are very pretty, being shaped like little rowboats with one seat. The shallow-water boats are flat-bottomed and thin, while the deep-water ones are much stouter and round-bottomed. Limpets each have a particular spot on the rock to which they attach themselves, and when they wander off between the tides for their dinners of seaweed they always return to the same spot. If you should try to pull a limpet off of his stone you would find it very hard work, for his strong foot sucks the rock with great force, and as soon as he felt you pulling or prying he would redouble his energies to cling to his home and would probably succeed.

A king among shells is the *Haliotis*, or, as the Spaniards call it, *abalone*. It is found in all collections, and is extensively used for its pearly lining in the manufacture of buttons, buckles, and other ornaments. It is sometimes called the ear shell, on account

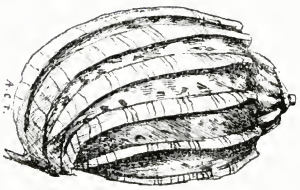


Natica heros (1) and egg mass (2), known as "sand-saucer."

of its resemblance to the outline of the human ear. In life the animal thrusts his tentacles out through the row of holes along the edge. On the outside the shell is rough, often closely resembling the rocks on which it lives. The animals are eaten in Europe and by the Chinese in California. While I was living in San Francisco a Chinaman went out on to the rocks at low tide to gather some. As he attempted to wrench one from its

home his hand was caught between shell and rock, and so firmly held by the animal that he could not escape the rising tide, and was drowned.

The pearly lining of the abalone is richly shaded with all colors of the rainbow, an opalescent green often predominating. The mother-of-pearl is composed of undulating layers. The iridescence is caused by minute lines reflecting different spectra.



HARP SHELL (*Harpa ventricosa*).

Some members of the snail family, with their world-wide reputation for slowness, have made amazing progress in the ascending scale. They have gone so far as to develep from the gills, with which they breathed in the water, lungs suitable for air-breathing, and have come to enjoy the pleasures which a life on *terra firma* affords. You can find them in the woods or in your garden, thrusting out their inquisitive little heads and investigating everything with their eye-tipped feelers. Some snails, after trying the experiment of a land life, have decided that on the whole a water life is preferable, and gone back to live there, where they have developed gills again, but of a different kind from the original ones.

There are sea snails, pond and river snails, as well as land snails. Many of them are carnivorous and can bore into other shells with their lingual ribbons. The hole usually strikes a muscle, when the shell gapes open, and his snailship enters and devours his prey.

Some kinds of snails, especially the land group, can live for a great length of time without food. A snail was fastened to a card and put in the British Museum in 1846. Four years afterward a discoloration appeared on the card, showing that he had been moving about. He was taken out, immersed in warm water, and was soon quite lively.

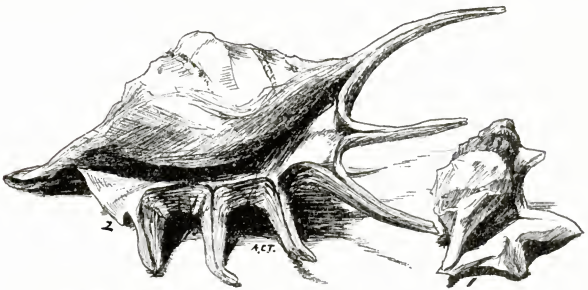
In creeping about, the snails always leave a track of mucus, which glistens when it is dry. It is in this mucus that they immure themselves for their long winter's nap, sometimes making several layers or partitions over the opening to the shell.

In the middle ages snail shells were worn as amulets, protecting the wearer against certain diseases as well as witchcraft.

Prof. J. S. Kingsley says of one North American species (*Helix harpa*): "In motion it is exceedingly graceful, at times poising its beautiful shell above its body and twirling it around, . . . again hugging its pretty harp close to its body."

The shells of the common wood snails are quite transparent

and pale brown, but some of the land snails have splendid houses. One in my cabinet is in broad bands of white and brown, lined with rose color. The violet sea snail is one of the most fascinating of all the group. Great herds of these bright, purple creatures are sometimes seen on the surface of the ocean feeding upon *Medusæ* (jellyfish). Each carries an enormous float, from the under side of which the eggs hang down. The float is formed



Pterocera lambis, showing prongs made by mantle. PELICAN'S FOOT (*Aporrhaispes pelicani*).

by a secretion from the foot and is made up of a great many little bubbles. When storms occur the floats often become separated from the creatures to which they were attached, but the eggs develop just as well. The violet snail is never found on shore, except when cast up by violent storms, being a lover of the high seas.

The largest littoral (shore-inhabiting) univalve on the Massachusetts coast is a common globular snail (*Natica heros*). It lives on clams and other bivalves, and is interesting on account of its curious egg masses, known to the children who gather them on the beaches as "sand-saucers."

The olive shells are so called from their resemblance to that fruit. They are all pretty, being curiously marked with different shades of brown, but the most striking of the family is the East Indian harp shell, which is very beautiful, with its longitudinal ribs, representing the strings of the harp. The animal which lives in it is exceedingly shy, and if it is captured it draws itself into the shell as far as possible. The whole of the foot will not go in, however, and this is quickly drawn across the sharp edge of the aperture and cut off. If the animal is set free again in its native element it will redevelop its foot.

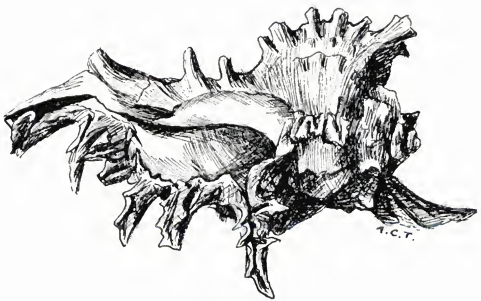
The miter shells are varied and brilliant in coloring. Some of mine are white with orange spots, others brown and purple, and all showy. They are named from their resemblance to the

bishop's miter, and are found in the Philippine Islands. If an enemy approaches, their occupants throw out a purple fluid and escape under cover of the stained water.

Notice in the miter shell how the color spots correspond to the whorls, in the scallops how the shades and bands follow the lines of growth. Have you ever thought why this is so? The mantle which builds the shell has spots or bands of color scattered through it, and as it works, the impressions of these same pigment spots are left on the shell. If the pigment cells of the mantle be yellow, red, or violet, these colors will be left on the shell and preserved forever.

Another marvelous accomplishment of the mantle is the ornamentation of shells with prongs, flutings, etc. We have a good example of this in the lovely *Murex* shells. The mantle sometimes works without cessation until the shell is finished, then turns up, forming the lip (the edge of the aperture). Often it works for a time, turns up, forming a frill or row of points, and rests. Then it begins its labors anew, building an addition and ornamenting it in like manner. Sometimes the mantle turns up at the end in a number of fingerlike radiations, as in the *Pterocera lambis* and curious pelican's foot.

The cowries form an immense group, some species of which inhabit almost every shore. They are called porcelain shells, on



Murex ramosus.

account of their glossy, smooth texture. The little white cowries are used in some parts of Africa for money and to make girdles for the high chiefs. A stripe of a different shade from the body of the shell runs along the back, showing where the edges of the mantle met. In life it entirely covers the outside of the shell.

The helmet shells of warm seas are used for making exquisite cameos, the best being cut at Rome. The raised figure is chis-

eled out of the white layer and rests on a colored groundwork, blue, pale salmon, etc.

A very strange little fellow is *Rhizochilus antipatharum*. In his youth he has a well-formed shell, but as he grows older he cements about it bits of coral, other shells, and anything which he finds convenient, until the opening is entirely closed, and he can communicate with the outer world only by means of his siphon.

One of the largest shells found on the coasts of the northern and middle Atlantic States is *Scycotypus canaliculatus*. It is protected from injury by its coat of rough brown fur. The inhabitant comes ashore to lay her eggs, which are a great curiosity. There are hundreds of little leaflike sacs which contain the eggs, all joined together, forming a long chain.

Æons ago the shells had very different forms from those of to-day, but we have left a few members of the group which existed in countless millions. The nautilus of the present time is not a very distant relative of the ammonites, which we find so marvelously preserved in the Silurian deposit, every line and penciling absolutely perfect.

NOTE.—I am greatly indebted to Prof. J. S. Kingsley, who was my teacher of biology at Tufts College, for his assistance to me when I was studying the shells, and for material in this sketch taken from his article on Mollusca in the Standard Natural History.

THE EMPLOYMENT OF THE MOTOR ACTIVITIES IN TEACHING.

BY PROF. EDWARD R. SHAW, PH. D.,
DEAN OF THE FACULTY OF PEDAGOGY, NEW YORK UNIVERSITY.

THE recent development of our knowledge of the nervous mechanism in its relation to the processes of education leads us to appreciate the great worth of the ideas advanced by two educators of the last century, Basedow and Heusinger, and also to see quite clearly the great advantage which will result in the work of the school from the applications of the truths set forth by them.

When Basedow said that children were fond of noise and movement, that they hated to sit still for a long time, that a continued strain of attention and learning by rote were distasteful to them, and that only by force could they be trained to such vexatious employments, he apprehended a truth upon which the researches of recent years have given us more specific knowledge; and his warning that through the disregard of this principle not only the health of the pupils is weakened, but also their intellect

and natural desire for knowledge, teachers are just becoming able to heed through the newer knowledge of child life and development.

Heusinger, a name little known, showed his great insight into this matter when he urged teachers to change and adapt their work so as to take advantage of the extreme impulse in children to be busy; for Heusinger maintained that, considering the great power given to this impulse by Nature, a prominent place in the development of man should be granted to it, and that it is the duty of teachers to give heed to this impulse in which an effective means of instruction is afforded. He set up this impulse to activity as the regulating principle in gaining knowledge, for he asserted that not only does it lead to a deeper knowledge of the thing itself, but also to a greater appreciation of all that is in connection with the thing, and also that it excludes those things which have no relation to the particular object of thought.

Froebel's apprehension of this truth is shown by his plays and games.

All these educators apprehended the fact that the most marked characteristic of the child and the youth is physical activity. This activity is due to an energy that must be expended through motor channels. It will perhaps make my contention the clearer if we consider briefly the young infant and examine the first manifestations of this energy and what results therefrom in mental development. The activity of a young infant must, I think, be conceded. Its arms and legs move vigorously. These movements are not determined by itself, are not controlled by itself. In various ways it often hurts itself by these uncontrolled motions, and in these movements there is at this period no will. These movements which all have recognized are impulsive in their nature—that is, they are set on not by any external stimulation, but by the accumulation of energy in the cells of the nervous system, and when the cells are filled with nerve force or energy the discharge of this energy is necessary for the growth and development of the system; and so the kickings and twistings and strikings and clutchings result. One suggestive point which may be noted here is the fact that when the cells become filled with energy they discharge. No demands are made on them before they are ready to act, for Mother Nature is the babe's wise teacher.

Closely following the impulsive movements, and indeed accompanying them, are what are termed reflex movements, which differ from impulsive movements in the fact that they are initiated or started by some external stimulation through some of the avenues of sense.

All impulsive and reflex movements occur without any pre-

meditation on the part of the child. They do not enter into consciousness during their performance, but are often remembered after they have been performed. The images left in the memory after these movements have been executed are a very great factor in the development of the will, for the voluntary movements which develop later are based upon these impulsive and reflex movements.

Beginning somewhat later than the impulsive and reflex movements are the *instinctive* movements. We may say that the instinctive movements are an advance on the reflex movements, as they are more complex, they enter somewhat into consciousness, and there is a purpose in them, though the child does not know at the time he performs the movement the end that is to be attained.

The first movements of the child are impulsive and reflex, and no self-consciousness accompanies them. Yet every movement, whether impulsive or reflex, leaves some slight trace in the developing brain, and when the movement is hit upon again, and then again, and still many times again, this trace strengthens and associates itself with the particular movement, and there arises in the dawning consciousness an idea, the elements of which are very largely motor; and so numerous motor ideas arise. The three classes of movements which I have described are involuntary, and out of all these various involuntary movements spring up motor ideas. The pleasure or pain necessarily accompanying these gives rise in consciousness to desire to repeat these movements or to inhibit or stop them. Deliberative or voluntary movements are not possible without motor ideas. Through these motor ideas the child comes gradually to represent to himself some end to be attained or avoided. To say, then, that the will develops first through the motor side is warrantable.

I have indicated how motor ideas are involved at the start in the psychic or mental life, and how it is "only after a motion has taken place that the child acquires any knowledge of its own motor act." We must not, however, lose sight of the fact that there is blended or associated with the motor acts sensations coming from the eye and the ear and from other sensory avenues. Involved in all these motor acts is an extensive part of the cortex of the brain called the motor centers, because all muscular movements are controlled from these centers. Not only do these motor centers play a great part in the development of the psychic life and the rise of the will, but all other parts of the brain come to be developed in communication with them. Prof. Baldwin has expressed the idea that it is the motor which holds the sensory elements together, and Dr. Crichton Browne has said that an analysis of our ideas reveals to us that we have few if any of purely sensory characteristics. All our ideas, then, have impor-

tant motor elements. Dr. Browne says further that "the muscles not only by the locomotion which they make possible enormously widen the field from which our sense impressions are gathered, but also, by the experience which their own activities involve, expand our mental resources a thousandfold."

How does this come about? it will be asked. Let one reach out his hand in any fashion, and he knows exactly what movement he has made. Does he know because he saw what he did? Then let him close his eyes and move his hand in any other fashion, and he knows just as well what the movement was as if the act were performed with eyes open. Did he know it because he had willed to move the hand thus? Not so. It must be granted that he willed to do it, and pictured in his mind previously the movement to be made; but that was the end of it in one particular. From that point it disappeared from his consciousness. The picturing of the movement with the intention to make it was the last thing he was conscious of so far as the movement is concerned. Because of that willing a discharge was set off from the motor centers, and the next thing in his consciousness was a perception coming from the sensations which arose from the movement. He then compared that perception with the previous image of the willed movement. They agreed, and he knew just the movement he had made.

But it will now be asked, How do sensations arise from the movement? Such a question is most pertinent at this point. Sensations arise from movement because there are distributed through the muscles, the joints, ligaments, and tendons, even the skin itself, sensory nerve ends which are affected by the movement and convey to the brain sensations of that movement. Out of these sensations the mind perceives what has been done. There is, then, connected with the motor or muscular side an important sensory side. We may go further than to say it is connected with the motor side; it is really imbedded in it. This important sensory side, it will therefore be seen, can not perform its function and carry information to the brain unless the motor side is used; and the more various the employment of the motor side, the larger the knowledge stored up in the brain from its sensory counterpart. The motor and the related sensory are developed *by* and *with* each other. The ideas resulting therefrom are sensory-motor ideas; and we have at last come to have some scientific appreciation of the far-reaching importance of these sensory-motor ideas as a part of the structure of the mind and as a means of producing fuller as well as higher mental development.

Ideas of time and place and position in their basic and most important elements are motor. Ideas of form involve more of motor impressions than of optical impressions. By the use of

the motor side the child's judgments are enormously increased and are made more accurate. This is necessarily true because by the use of the motor side his opportunities for comparison and discrimination are multiplied. He is called upon, for instance, to form a judgment out of the ideas already in his possession. If now he stops with this judgment he has no new criteria with which to judge its correctness. On the other hand, if he can convert this judgment into motor terms a comparison is forthwith instituted and the judgment undergoes revision.

I have already spoken of the physical activity of youth as a marked characteristic, and have said that this activity is due to the discharge of energy into motor channels. It is a significant fact that the attention of the child can be held for a surprisingly long time provided he is so employed that this motor energy is expended in movement. Attention from the first is therefore closely related to the motor side. The reason seems to be that there are many groups of cells more or less isolated from each other, but each closely connected with the main branches of the nervous system. Each group has functions largely peculiar to itself; when the brain is fully developed these isolated groups of cells become more closely interrelated by means of filamentary outgrowths, called by some writers pathways of association and by others dynamic pathways, by which energy is more readily distributed to various groups. In other words, if I may use a bold metaphor, short circuits become at last established between the various centers, so that the energy is not discharged into the early isolated channels. If, therefore, we wish to hold the child's attention to any particular line of study, we must at the same time provide for the expenditure of the energy that is gathered in the other groups of cells whose connections of interrelation are not yet built up or established. If we do not provide for this, the natural discharge of the energy from the overfilled cells of those other groups swerves the child's attention from what we have in hand for him. Every mental act, it must be remembered, involves the complete arc of the sensory and the motor, and in the child the inherent stress is on the motor. Again I quote from Prof. Baldwin: "Just in as far as the motor ingredient of a mental content of any kind is large—that is, in so far as the sensory ingredient is intense—just to this degree also will the direction of attention be secured, and to this degree also will both the ingredients be intensified by this act of attention. Intensity draws attention, and attention increases intensity—the law of sensory-motor association—i. e., *every mental state is a complex of sensory and motor elements, and any influence which strengthens the one tends to strengthen the other also.*"

I have spoken of how the use of the motor side adds new ave-

nues of perception, of how it increases the number of judgments and the accuracy of them. It enriches also in content our ideas of form, of time, of distance, of place, of resistance, etc.

Association, moreover, is very closely related to this side, and the employment of the motor activities in mental acquirement aids memory. Prof. Baldwin says very emphatically that association has a motor foundation from the first, and that the elements hold together in memory because they are used together in action, and as action becomes one, but yet complex, so the mental content tends to become one, yet complex. He says further: "We have to-day got beyond the view that memory is a faculty which takes up content and remembers it. It is, on the contrary, now known to be a function of the content remembered." In my view this function of the content depends upon the variety of association and also upon volition, and both of these are best built up by that which gives the fullest possible functioning of the nervous mechanism during its developing period—namely, the fullest and most varied use of the motor activities warrantable. This, bear in mind, means a much more prominent use of these activities than has yet been made in our schools.

In the act of teaching or learning, old elements are constantly revived through extrinsic stimulation and volition. But it is, after all, the motor which sets those processes going that revive the older mental elements, and it is through the motor that the older elements have placed beside them images and judgments containing a greater number of elements than they would otherwise have had. Thus arises a more varied association. The new impressions become blended with the old, but at the same time the new have more elements in them because of the development of the motor side. Accordingly, the new content is a fuller one—that is, it has more clews by which its revival may be produced. For Donaldson, in those two remarkable chapters which close his recent work, The Growth of the Brain, not only expressly says that "education consists in modifications of the central nervous system," but also that "the value of mental images appears also as dependent on the number and balance of the secondary sensations which accompany them. The greater the number of these, the more certain and precise is our thought," and "as the possibility of forming the extra images is curtailed, the conception becomes weaker, more special, and less reliable."

The reasons why we attribute such value to paper folding, drawing, coloring, clay modeling, of late so largely introduced into courses of study and with such profit both to pupil and to teacher, must now be very evident. On the same grounds manual training is appreciated to-day, and is winning wider adoption because of its employment of the motor activities. It may be said,

however, in passing, that the various exercises now laid down in courses of manual training will all have to be examined in the light of the scientific methods already employed in studying the older practices in education, to determine not only what value these exercises have, but also their sequence, and doubtless to cast aside considerable that is at present recommended. Thirty-five years ago object lessons were strongly advocated in this country. They brought new life and spirit into the schools, and became widely adopted. But to-day, without object teaching, all that was then gained by it is secured and much more by Nature study or science work, that which object teaching has led up to. And through a similar process of evolution many of the formal exercises of manual training are destined to disappear and to be correlated with other kinds of work, so that a broader purpose will be subserved through the use of the motor side.

The reader will recall the statements already made that attention is strongest when the motor side is employed, and that association and memory seem more closely related to this side. There is, however, another ingredient entering into all this which we have not yet mentioned. It is that with the proper expenditure of motor energy there arise interest and pleasure—an emotional condition which of itself materially strengthens memory and association.

When we call to mind that the child's mental world is largely an unrelated world, we find another reason for urging a larger recognition of this principle in our teaching. The child is in an unrelated world, because he is in the midst of innumerable objects, manifestations of complex and varied phenomena, the succession of events and their occurrences simultaneously. The stimuli which constantly stream in produce very strong sensations, and innumerable sense judgments are formed more or less unrelated. One of the most difficult tasks of the teacher is to lead the child to relate these judgments, to reject the unessential and unrelated, and to arrange the ideas growing out of those judgments in series; in other words, to introduce coherence and unity into the child's mental life. But this mental unity can not be considered apart from the matter of physical growth. The child's brain at birth weighs about one fourth of what it weighs at maturity, and the proportionate increase of other tissue in the body during the period of growth is considerably greater than the proportionate increase in brain weight. That which helps the child to gain nervous control will accordingly help greatly in bringing unity into his mental life, and no other means at the teacher's command will contribute so much toward what Prof. Baldwin has so happily styled nervous and mental unity, as a large employment of motor activity in schoolroom work.

If, then, we go into our schools with this idea in mind and examine the methods of teaching we can not fail to discern what a disregard there is of this important principle. Better results would be obtained—incomparably better—could there be a change in this regard in the methods of the schoolroom.

I do not ask for license, but for orderly activity—educative activity. It was in 1797 that Johann Heinrich Gotlieb Heusinger, Docent in Philosophy and Pedagogics at the University of Jena, apprehended this important principle, and expressed his surprise that teachers had not heretofore recognized this impulse of children to activity and taken advantage of it in the work of instruction. It is not the first instance in which the truth of an idea has been recognized a century after its expression. And it is a source of much pleasure to me to offer some of my pedagogical worship at the shrine of Heusinger.

In the different branches of study, then, which pupils pursue in our schools, and which they try to master in order to acquire a fair education, there are numerous places and many topics that admit of the employment of the motor side, if teachers had but the versatility and inventive talent to make the application. Time would be economized, broader mental development would be given to the child, and discipline would take care of itself, for it is undirected motor energy that produces so much trouble in the matter of discipline, and unused motor energy that produces so much fatigue in pupils during school hours.

In order that this article may not seem to be too largely theoretical, and also to show, if possible, more clearly what has already been set forth, I shall endeavor to point out some applications of the employment of the motor side in actual school work. A moment's thought will lead one to see that there are some studies where the employment of the motor activities is much more difficult than in others. Perhaps the most difficult of all subjects is in teaching reading to a class of beginners. In this particular I got my first suggestion from a visit to a little *Dorf* school in Germany. What I saw appealed to me as a simple and at the same time a remarkable application of the principle I have tried to give exposition to here. I doubt whether the kind, genial schoolmaster had ever read Heusinger's essay or had ever heard his name. I do not think he himself appreciated how scientific, how in accord with the best knowledge of to-day, the lesson he gave in reading to the lowest class really was. The spirit of that little village school, the work and the relations between teacher and pupils, were most beautiful and ideal. In three visits to Germany I never saw any other school comparable with it. Instruction by means of orderly activity, and much of it, were the aim. Activity was not suppressed; it was directed and controlled and made to

help powerfully in securing that equipment of knowledge for which schools are established. The reading lesson I have referred to was given to the lowest class, with one little boy in it not yet five, which the master had allowed to enter.

The reader will assent, I have no doubt, when I say that learning to read makes a severe demand upon the attention, and there is perhaps no other subject, when we consider the way it is usually taught, that tires the pupil so quickly, simply because we do not provide for the employment of the energy that must be discharged into other channels. The act of recognizing and learning new words uses only a small part of the energy which the various groups of nerve cells are constantly accumulating in the healthy and growing child. Now this gentle, sunny German schoolmaster, who was every whit a man, focused the attention of his little class upon the words he wished that day to teach them, and added interest and delight to the exercise because he made other demands than those upon the eye and the voice and the ear. There were five words in the lesson, and the lesson lasted just five minutes, after which the little class went to a table in another part of the room and took up number work. The words of the reading lesson were Hut, Rad, Fisch, Topf, Sichel. The letters were printed on pieces of cardboard about two inches and a half square, and these were placed in the shallow trough of the blackboard in the order demanded by the words. Each pupil when called upon made a vigorous striking gesture as he pointed to each letter, giving at the same time the sound of the letter. When he had sounded each letter of the word in this manner he made another gesture, this time from left to right as if to blend all the sounds, pronouncing the word as he made the gesture. Then the little group in concert spelled and pronounced the word in the same fashion. The next pupil went through the same exercise with the second word, and so on for each pupil. Sometimes the master would tip the letters of a word over on to the floor and direct one of the pupils to pick them up and put them back in proper order; or he would take the letter cards, mix them up, and direct a pupil to put them back in the trough in their proper order.

In the Heusinger School, lately organized to give application to these principles, this plan of letting children point singly and then together to the letters of words written on the board has been used as one way of providing motor activity while teaching beginners to read. But variety is necessary, and as another way of securing this the pupil, when he has read his sentence, goes to the blackboard and writes it, then to the table, picks out the printed or script letters according as he has been directed, and forms on a tablet these letters into the sentence, and then takes

this to the teacher for her approval. If it seems necessary to have the child write the same sentence several times, the mere matter of directing him to write the sentence on one board, then to go to the next board and write it, and then back to the first to write it a third time, gives him pleasure, enhances his interest, and strengthens his power to make effort. And thus much orderly activity is combined with all reading exercises. I may remark in passing that during the child's first year at school he is kept in his seat less than one fourth of the time. The desk, if the matter is not closely watched, proves a fatal obstacle to the employment of the child's motor energy, not only in the first year but in the succeeding years.

Arithmetic is a subject which presents large opportunities for the employment of the motor activities in teaching it, and the advocates of manual training ought to have shown us long ago how nearly the whole of arithmetic can be taught through manual-training exercises. Such a correlation is possible. But those schools which have stood for manual training from the first, and which possess to-day magnificent equipments, seem not to have apprehended that these two subjects of their curriculum can be made to go hand in hand. Because of their opportunities they should have worked out for the benefit of the educational world a method of teaching arithmetic and at the same time manual training in wood and metals.

But more convenient materials than wood or metal are at our command for the ordinary schoolroom. Paper and cardboard admit of tridimensional constructions in great variety, and by the folding and cutting of paper all necessary space-forms of two dimensions are easily made. Then, too, the floor, and even the conventional blackboard, can be brought into much larger requisition for the drawing of plans and diagrams. Scales and weights, measures of capacity, and other concrete objects and appliances can be brought into service. Moreover, buying, measuring, and selling should have a place. By the use of all these accessories, in graded exercises throughout the whole course of arithmetic from the class of beginners to the class completing the study, large employment can be given to the motor activities. Such procedure would render the instruction in arithmetic less formal and more informing, and would incite a greater degree of interest in pupils.

Inventional geometry is a subject which is regarded by all who have had experience in teaching it as a most interesting and educative study.*

The series of problems devised by William George Spencer

* See Popular Science Monthly, January, 1889.

stand pre-eminently above any other series yet published. The little book exemplifies most thoroughly the principle of apperception. Its exercises are very carefully graded. The steps are for the most part just difficult enough, so that the pupil is able, by using the ideas he has already gained, and the power he has acquired in gaining those ideas, to solve the next step. The book is based upon the heuristic or inventive method of teaching, and is a remarkable example of this. These factors unquestionably contribute much to the delight which pupils find in this study. But these factors, valuable as they are, are not sufficient to account for the command which pupils possess over the knowledge gained and their power to revive that knowledge and use it, as well as to find interest in it long after they have passed their examinations and have laid the study aside. There is another potent factor assisting these. The exercises call into use a very important part of the motor side. The pupil is continually busy with his hands as he brings into requisition ruler, compasses, pencil, pen, etc. The hands and the eye work in harmonious conjunction, and thus important motor elements become constituent parts of the notions and judgments acquired. An augmented power of perception, and consequently greater stimulation, results, and because of this the pupil produces forms which would not be produced if he studied printed diagrams and tried to build these up in imagination. Accordingly, his judgments of the relations of lines, angles, surfaces, planes, solids, and areas are multiplied to an enormous extent.

The last application I shall point out is in a branch of study where the employment of the motor side would be least thought of, and where it would lessen the burdens of pupils and preclude the discomfiture of teachers. The branch of study referred to is that of modern languages. Books are the repositories of knowledge, we have been told, but that is no reason why the pupil should begin and end his acquirement of a modern language by closely adhering to the pages of a text-book. I trust the reader will not misinterpret me. I do not wish to abolish text-books. I would not, however, by their use hold the child down to one narrow avenue of acquirement. The printed page is greatly like a photograph—it gives but one point of view. It must, however, be conceded in this connection that there are a few, a very small percentage, of those who enter upon the study of a foreign language that apparently get on easily with acquirement from the printed page. Most teachers of the languages doubtless belong to this class, but that is no reason why the method by which they learned should hold sway. The fact is that a large majority of students do find this way of acquirement very hard, and many become discouraged and give up effort. I think it will be conceded that the

principal factor in learning a foreign language is manifold association. The vocabularies in text-books are printed with the English equivalent after each word. The pupil is required to learn and recite those vocabularies and then to apply the knowledge in reading and writing sentences. It must be apparent that this method affords but a narrow ground of association, and difficult recollection is, of course, inevitable. It has been shown that when foreign words are printed and are followed by a picture of the object instead of the equivalent word in the vernacular, memory is largely aided.

Excellent as is this plan, however, it can not be used in connection with all the parts of speech, but must be confined principally to one class of words. When, however, we make use of the motor side, first creating through this means the idea in the mind of the pupil and afterward giving, in the foreign tongue, the expression of this idea without the employment of English as an intermediary, we are not only taking the most direct way to lead the pupil to understand and think according to the idiom of the language he wishes to learn, but we are also economizing mental effort on his part, because the largest acquirement results from the effort expended. In a future article I purpose to discuss more fully this particular topic, and to describe some experiments now being made for the purpose of developing a method of teaching German according to this principle.

DOUBLE PERSONALITY.

By Prof. WILLIAM ROMAINE NEWBOLD.

BEFORE discussing the conception of double personality, it may be as well briefly to review the conceptions of which I have so far made use. I have held that the human mind must be conceived as a complex system of elements which is capable of greater or less degrees of disruption or disordination without the total destruction of its component elements. Disordination often takes place normally while falling asleep; it can be artificially produced by the use of certain drugs, and, in some persons, by concentration of attention; it is also found in some diseases, notably epilepsy and hysteria. In disordination the dissociated elements which remain work out their normal results with more fatal precision than usual; from this fact spring the phenomena of suggestibility, trance, and ecstasy, and some forms of hallucination and automatism. Frequently the dissociated elements recombine in new forms, some of the constituents of the former consciousness being omitted and new ones appearing; this gives

rise to secondary states of all kinds, such as somnambulisms and successive modifications of the self.

The very conception of disordination involves the notion that mind may exist in forms very different from those with which we are familiar. For the present I shall limit the word "consciousness" to such an orderly system as yours or mine. The disordinated condition I would describe as "amorphous mind" —what I mean by that I will try to show a little further on.

In my last paper I discussed three typical cases in which the elements of personality seemed to have recombined in new forms, but throughout that discussion I tacitly assumed that the elements which were peculiar to one system became extinct upon the formation of another. From our present point of view this is the most natural assumption, and there was, in those cases, no evidence to the contrary. But that assumption is not essential to the theory, and often seems inconsistent with the facts.

Apparent evidence for the existence of mind in connection with a body of which the consciousness belonging to that body has no knowledge is not unusual, and I have given some illustrations of it in my recent papers. But the interpretation of such phenomena is not easy.

Since our first-hand knowledge of mind is nearly always in the form of a personal consciousness or self, one is at first inclined to ascribe such manifestations to a self. But since they are denied by the normal self, it would then be necessary to assume the existence of a second self in order to account for them, and this second self is conceived by some as existing beneath the level of the normal self and as having its own memories, interests, hopes, and fears, as acquainted with the existence of the upper self, and as bearing to it a relation sometimes hostile, sometimes benignant.

Of this theory and its congeners I shall have more to say at another time; for the present I must confine myself to that which I am developing. According to it the evidence which is sufficient to establish the existence of a mental event may be and usually is wholly insufficient to establish that of a personality or self. When an automatic hand writes a message of which the upper consciousness knows nothing—a point, by the way, very hard to prove—we have evidence for the existence of a mental event; but if we ascribe it to a person of any sort, we are practically adding to it, without evidence, a multitude of mental events combined in definite ways.

Yet if a personality is no more than a system of mental states organized in a certain way, why should not the elements dissociated from the upper consciousness recombine and form a second-

ary self which may exist simultaneously with the upper self, and in a way beneath it as above described?

There is good reason for thinking that they do, to some extent—to what extent is a question more easily asked than answered. In the first place, if the two groups are to be entirely distinct, there scarcely seems to be enough mental material to go around. The primary system would be so maimed and the secondary so incomplete that one could scarcely regard either as a full-fledged personality. If certain elements are to be simultaneously held in common by both groups the case would be different, but, so far as I know, there is no good evidence for this. In the second place, the will, or sense of effort, which I believe to be the essence of the self, raises a serious difficulty. We practically know nothing of its nature. The rival theories may be regarded as falling under two heads—those that make will but a name for the control exerted by the more complex ideas over the more simple, and those that make it something absolutely unique in mental life, and in no respect analogous to the control exerted by ideas, whether complex or simple. If we adopt the first, it is hard to believe that the secondary system could attain the degree of complexity necessary to the manifestation of will without destroying the complexity of the primary; if we adopt the second, it is as hard to believe that two of these unique phenomena should appear in one body. If the secondary system manifested a will of its own, we should expect to find that the primary had lost it, and then we would not have two simultaneous selves, but merely successive modifications of the original self, as in the cases discussed in my last paper.

Turning now from the abstract to the concrete, I shall give some of the facts upon which these conceptions are based. First I shall take up the case of Prof. Pierre Janet's famous patient Lucie, and show how he tried to prove in her the existence of subconscious states, and how he apparently succeeded in organizing them into a sort of dream self which existed only in his presence, faded away when he departed, and finally vanished when Lucie recovered her health. Then I shall try to throw a little light upon the actual character of this "amorphous mind" and the relations which may exist between secondary states and the primary system.

When Lucie fell into Prof. Janet's hands,* she was about nineteen years of age. She was intelligent, quick-witted, hot-tempered, and had a strong will of her own. She had wholly lost her sensa-

* The most detailed accounts of Lucie's case are in Prof. Janet's articles in the *Revue Philosophique*, vol. xxii, pp. 577–592; vol. xxiii, pp. 449–572. More facts are to be found in his work *L'Automatisme Psychologique* and in his other writings.

tions of touch, pain and temperature and all those sensations from the muscles and joints which make one aware of the position of one's limbs, so that, as she herself said, she "lost her legs in bed." Her other sensations were normal. She was subject to frightful hystero-epileptic convulsions which came on every day and lasted about five hours. During them she seemed delirious and talked constantly about men hidden behind curtains, but could not make intelligible what it was that troubled her. Her memory was good on the whole, but she never recalled anything that happened during these attacks, nor could she remember ever having had the sensations which she had lost.

When hypnotized, she was extremely suggestible, performed posthypnotic suggestions with fatal precision, but *never seemed conscious of what she was doing.* For example, she would carry her hands above her head in obedience to such a suggestion and yet stoutly maintain that they were in her lap. The same results could be got without hypnotizing her by simply distracting her attention. Some one would engage her in lively conversation while Prof. Janet whispered a command in her ear; the command would be obeyed, but Lucie would profess ignorance both of the command and of its execution. After a while the mere tone of command produced the same effect. Lucie would hear all that Prof. Janet said to her before and after the command, but the command itself was unheard by her, although invariably obeyed.

The significant feature of these experiments is that commands not heard by Lucie were obeyed by her body. In like manner, suggestions given through the sense of touch, which Lucie had wholly lost, were obeyed. If Prof. Janet clinched her fist, it would strike out and her face would assume an angry expression; if he carried her fingers to her lips, the lips smiled and the fingers threw kisses. Signals of the most complex kind were obeyed in the same way. She was told to perform a posthypnotic suggestion when Prof. Janet had clapped his hands twelve times. He then clapped his hands five times gently and at a distance from her while she was talking with some one else; he asked her what he had been doing and she could not tell him. He clapped his hands again and asked what that was. A handclap, she said. After waiting until her attention was again distracted he clapped them six times more, and the suggestion was obeyed. Lucie could remember having heard only one of the claps, but all twelve were in some way counted. He varied this experiment in many ways, but always with the same result.

Believing, then, that mental states really existed in Lucie's head, so to speak, of which she knew nothing, Prof. Janet next endeavored to get them more fully expressed than was possible in gestures and obedience. Since all talking was done by Lucie,

he tried writing, and found, to his delight, that when her anæsthetic hand was hidden from her sight by a screen he could get answers to his questions in writing without Lucie's knowing that it was writing at all, much less what it said. At first it showed little or no spontaneity, and unless the content of the writing was determined by his suggestions it was limited to "Yes," "No," and "I don't know." He asked for a letter, and it wrote an apologetic refusal of an invitation; he asked it to solve little arithmetical problems, and if they were not very difficult it did so correctly while Lucie was talking or reading aloud or otherwise occupied. But there was never a sign of a self-conscious personality in the narrower sense of the word. The writer did not claim to be anybody in particular, and volunteered no information about herself.

One day Prof. Janet undertook to inquire into this point, as follows: "Do you hear me?" "No." "But you must, to answer." "Of course." "Then how do you do it?" "I do not know." "There must be some one who hears me?" "Yes." "Who, then?" "Some other person than Lucie." "Ah, some one else. Shall we name her Blanche?" "Yes, Blanche." But Lucie abhorred the name Blanche, and when the writing was shown to her she flew into a rage and tried to tear it up. So the name was changed. "What will you have?" asked Prof. Janet. "No name." "But it will be more convenient." "Very well, Adrienne." "Well, Adrienne, do you hear me?" "Yes."

It seems probable that the notion of being a person was first suggested by Prof. Janet. However that may be, thenceforward all these automatic phenomena seemed to become crystallized about the name Adrienne and the voice and touch of Prof. Janet, and were readily evoked by him but by no one else.

Having thus got access to the secondary system, the next point was to determine what it comprised. In brief, it was found that all Lucie had lost, whether spontaneously or by suggestion, Adrienne had, and, *vice versa*, whatever Adrienne got, whether spontaneously or by suggestion, Lucie lost.

Lucie had lost her sense of touch, but Adrienne's was perfect. Suggestions given through the sense of touch were executed, but made no impression upon Lucie's consciousness; Adrienne claimed to experience the corresponding mental states. Prof. Janet clinched the left fist, and it struck out; he then asked the right hand, "What are you doing?" "I am furious." "With whom?" "With F——." "Why?" "I do not know, but I am angry." Then he unclasped the fist and put the fingers to the lips—the lips smile and the fingers throw kisses. "Adrienne, are you still angry?" "No, it is gone." "And now?" "I am in a good humor." "And Lucie?" "She knows nothing—she is asleep."

Lucie remembered nothing of her hypnotic states and the suggestions given in them, but Adrienne could tell all about both. Lucie knew nothing about her convulsive attacks. When Adrienne was questioned during a convulsion she could only write, "I am afraid, I am afraid," but afterward she gave an account of them which was intelligible enough, although a little incoherent. "I see a curtain first, and then hidden men, who frighten me. In the country once, at grandmother's house during the holidays, two men came; then in the garden a big curtain, which they put on the trees and went behind it, which frightened us, and since then I have always been afraid." Lucie knew she had had a fright when about seven years old, but never could tell what it was. Prof. Janet does not say whether he verified this story or not, but seems to regard it as true.

So of states artificially dissociated from Lucie by suggestion. Bits of paper were put in Lucie's lap, some of which were marked, and she was told that she could not see those that were marked. If Adrienne were asked what was in Lucie's lap, she would describe those only which Lucie could not see. In this way Adrienne was proved capable of distinguishing odd numbers from even and of performing other simple judgments. Whenever a suggestion was given to Adrienne, it and all that it involved were withdrawn from Lucie. While Adrienne was writing the numbers Lucie could not count, and while Adrienne was writing the alphabet Lucie "had forgotten it." In such cases as these the fact might easily escape notice, but when the elements thus subtracted from Lucie's consciousness were such as she would be likely to miss, she supplied their place by a sort of dream of her own. Thus, when Adrienne was told to put her arms above her head, Lucie lost all consciousness of their true position and said they were in her lap. When Prof. Janet established this fact, it supplied the explanation of an occurrence which had puzzled him not a little at the time it happened. Adrienne was told to come to Dr. Povilevitch's house at a certain time, and Lucie's body came. But Lucie believed herself still to be at home, and mistook the furniture for her own, while Adrienne knew perfectly where she was.

Prof. Janet desired to reverse the relative positions of the two systems so as to make Adrienne speak and Lucie write, and, finding that his suggestions to this end were unavailing, he put Lucie into a deep sleep to make her more suggestible. After sleeping a half hour she awoke, and to his surprise he found that he had neither Lucie nor Adrienne, but a new personality derived from the coalescence of both. This personality called herself Adrienne, but had all Lucie's memories and sensations in addition to those of Adrienne. She was more vivacious and intelligent than Lucie,

could not be distracted, and only laughed at Prof. Janet's attempts to give her suggestions. This new synthesis lasted only about twenty minutes; it was followed by a deep sleep of about fifteen minutes, and then Lucie awoke in her former condition.

At first, as I have said, Adrienne showed little spontaneity, but as time went on she acquired memories and developed more character. Once she got angry with Prof. Janet, and for some time all the tokens that showed her presence—automatic writing, catalepsy, and suggestibility—disappeared. When she was reconciled they came back again.

Adrienne existed after her first creation about six weeks. Then Prof. Janet undertook to cure Lucie by suggesting against her hysterical symptoms; little by little they disappeared, and with them Adrienne faded out of existence. "At last," says Prof. Janet, "one day I called upon Adrienne—it was Lucie that replied, laughing a good deal and asking whom I called Adrienne. A few days later the hypnotic sleep, which had ceased to be interesting, entirely disappeared, and it was found impossible to get Lucie asleep by any means."

For eight months Lucie was quite well. Then she had a relapse and Adrienne reappeared. For five days she remained evocable and then disappeared for the last time.

Since that time Prof. Janet has verified with many other patients the conclusions which he reached in the case of Lucie, and most of them have been confirmed in greater or less degree by other investigators in France, Austria, England, and America. But Lucie remains the best illustration of apparently simultaneous "double personality" that has yet been described.

We can not be too cautious in trying to picture to ourselves what the condition of this secondary system which called itself Adrienne really was, just as we can not be too cautious in trying to picture to ourselves the minds of the lower animals. It is much easier to say what Adrienne was not than what she was.

She was not a continuously existing, self-conscious being. She did not exist, in all probability, before Prof. Janet questioned the hand about the writer's name. She did not exist after Prof. Janet had left Lucie. No one but he could evoke Adrienne. Whenever he came into Lucie's presence a marked change came over her—she lost her vivacity, appeared subdued, almost timid, and then Adrienne could be elicited. It would seem that Prof. Janet was like a great magnet about which these dissociated subconscious elements gathered in a sort of dream self, but in his absence they again relapsed into their former incoherent condition.

What were they, then? Can we form any conception of what this "amorphous mind" is like?

I think we can to some degree and in some cases. In our own familiar dream life we have precisely those conditions realized which we suppose obtain in the subconscious realm of a hysteric. Nearly all sensations and most memories and ideas are withdrawn and the fragments remaining work out their own bizarre results free from the control of the organized system. We shall not be far wrong, I think, if we conceive of these subconscious states as a mere aggregation of very incoherent dreams. They are probably very much more incoherent than most of the dreams which we remember, although not more so than those that we forget. Under the guidance of a hypnotic suggestion, and under some other circumstances into which I can not now enter, they may become coherent to almost any degree.

There is a good deal of direct evidence for this. Prof. Janet found that he could sometimes, by awaking Lucie in the midst of a hallucination which he had suggested to her, get her to recall it, and she always spoke of it as a dream. Prof. Janet once tried * some experiments upon a patient whom he had not seen for some months. To his surprise she did not seem to understand him. When he asked why, she told him that she was too far away to understand; that M. X—— had sent her a month ago to Algiers, and he must bring her back before she could understand. This was found to be true: M. X—— had told her she was in Algiers, and had forgotten to remove the suggestion.

Another case will serve both to illustrate this point and also to introduce the question as to the relation between the primary and secondary systems. They need not be entirely distinct. Sometimes, as in this next case, the mere existence of the one may seem to disturb the other in some vague fashion, at other times scraps or fragments or consequences of either may appear in the other without their origin being recognized, and in still other cases the two appear to coalesce sufficiently for the one to recall the other while yet they remain dynamically distinct.

One of Mr. Gurney's patients † was told to write automatically while reading aloud. The result was that both reading and writing were imperfect and confused. He was then hypnotized again and asked what he had been trying to do. He said, "Trying to write, 'It has left off snowing.'" Then he was asked if he had been reading, and said: "Reading? No, I haven't been reading. Something seemed to disturb me; something seemed to move about in front of me, so that I got back into bed again." "Did not Mr. Gurney hold a book and make you read aloud?" "No. Somebody kept moving about. I did not like the looks of them.

* *L'Automatisme Psychologique*, second edition, p. 328.

† Proceedings of the Society for Psychical Research, vol. iv, p. 319.

Kept wandering to and fro. Horrible, awful. I thought to myself, 'I'll get into bed.' It looked so savage it quite unnerved me." Here the reciprocal interference seems quite clear, and the subconscious state, instead of evolving on the lines laid down by the suggestion, has been perturbed and developed into a vague dream.

Another good case of interference is given by Prof. Janet:* "M—— came to me one evening complaining of sundry troubles, and after putting her into her second state I talked to her and gave her some advice, then wakened her without thinking of repeating the same advice in her waking state. Some days later she wrote me the following letter: 'I can not make out what is the matter with me. I must be very queer. I understand with difficulty, and it seems to me that everybody is looking at me, perhaps because I express myself badly. I feel absolutely nothing, and I let nearly everything fall, which makes me seem very stupid. I can not work, and if any one in the house should notice it I should be the loser. I may be wrong, but I have a dim idea that I ought to do something. For two days I have tried in every way to discover what it can be.'" All this annoyance was easily removed by destroying the subconscious suggestion.

Upon this conception of the interference between the two states without coalescence and without the formation of a memory bond, Prof. Janet has based a most interesting and important theory as to the origin of the hysterical and nervous troubles which so often follow a severe accident or fright where no actual injury can be detected. It is well known that such an experience often becomes a conscious fixed idea, and "haunts" one. But sometimes where there is no conscious "haunting," and even where the experience is forgotten, the same results are traceable. In these cases he believes that the fixed idea exists subconsciously as a continuous or frequently recurring dream.

Thus, Vel—— is a young man of twenty-four.† About every five minutes while awake and often while asleep he expels his breath violently through the left nostril and the muscles of the right cheek are contracted. He has had this spasm for eight years and can not explain why. He thinks it may be connected with a severe hæmorrhage from the nose which he had as a child. He is easily hypnotized and then affirms most positively that there is an obstruction in his nose which he must get rid of. "No matter when he is put to sleep, he makes the same statement; it is probable that this idea has existed more or less clearly in the patient's mind, and in any case unknown to him, for eight years. This dream was modified and suppressed very easily in the somnambulic state."

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* *Les Accidents Mentaux*, p. 137. † Ibid., p. 102.

"A subconscious dream,* in which the movement of a limb is represented, tends to some extent to invade the primary consciousness and deprive it of control over that limb. Le —— dreams that he is fighting with a thief, and keeps off his assailant with his right hand; the thief puts his knee on his left side and clutches his neck with his hand. Upon awaking, Le —— has a hyperæsthetic point on the left side, pressure upon which is sufficient to bring on the complete hallucination of the scene, and has, further, an anæsthetic spot upon the neck with complete insensibility and almost complete paralysis of the right arm. Why do we find these two symptoms? Because these sensations of pressure on the neck and movement of the arm form, so to speak, part of the dream, are absorbed by it, and are no longer at the disposal of the self."

Sometimes we meet with cases in which the secondary system is not subconscious, but blends sufficiently with the primary system to be recalled, and at the same time retains its independent character. The experiences of Dr. Cocke and of Anna Katharina Emmerich, to which I allude in my paper on Hypnotic States, Trance, and Ecstasy, are of this type. Similar cases are not infrequent in insanity. One of the best accounts from normal life that I have seen is given by the late Robert Louis Stevenson in a letter to Mr. F. W. H. Myers, dated July 14, 1892:†

"During an illness at Nice I lay awake a whole night in extreme pain. From the beginning of the evening *one part of my mind* became possessed of a notion so grotesque and shapeless that it may best be described as a form of words. I thought the pain was, or was connected with, a wisp or coil of some sort; I knew not of what it consisted, nor yet where it was, and cared not; only I thought if the two ends were brought together the pain would cease. Now all the time, with *another part of my mind*, which I venture to think was *myself*, I was fully alive to the absurdity of this idea, knew it to be a mark of impaired sanity, and was engaged with *my other self* in perpetual conflict. *Myself* had nothing more at heart than to keep from my wife, who was nursing me, any hint of this ridiculous hallucination; the *other* was bound that she should be told of it and ordered to effect the cure. I believe it must have been well on in the morning before the fever (or *the other fellow*) triumphed, and I called my wife to my bedside, seized her savagely by the wrist, and looking on her with a face of fury, cried, 'Why do you not put the two ends together and put me out of pain?'"

In another illness, at Sydney, "*the other fellow* had an explana-

* *Op. cit.*, p. 132.

† Proceedings of the Society for Psychical Research, vol. ix, p. 9.

tion ready for my sufferings, of which I can only say that it had something to do with the navy, that it was sheer undiluted nonsense, had neither end nor beginning, and was insusceptible of being expressed in words. *Myself* knew this; yet I gave way, and my watcher was favored with some reference to the navy. Nor only that: *the other fellow* was annoyed—or I was annoyed—on two inconsistent accounts; first, because he had failed to make his meaning comprehensible, and, second, because the nurse displayed no interest. *The other fellow* would have liked to explain further, but *myself* was much hurt at having been got into this false position, and would be led no further."

Now, when such a disordinated system obtains complete control of the body, the patient is wholly insane. Not, of course, that every case of insanity belongs to this type, but that every case of this type belongs to insanity. The normal consciousness is then supposed to be wholly extinct, but there is no reason for believing that it necessarily must be. Take for example a case observed by the late Dr. Ira Barrows, of Providence, R. I., and printed by Prof. James.* The patient was a girl of nineteen. I make only a few extracts from Dr. Barrows's notes.

"*September 17, 1860.*—Wild with delirium. Tears her hair, pillowcases, bedclothes, both sheets, night dress, all to pieces. Her right hand prevents her left hand, by seizing and holding it, from tearing out her hair, but she tears her clothes with her left hand and teeth.

"*29th.*—Complains of great pain in right arm, more and more intense, when suddenly it falls down by her side. She looks at it in amazement. Thinks it belongs to some one else; is positive it is not hers. . . . She bites it, pounds it, pricks it, and in many ways seeks to drive it from her. She calls it 'Stump, old Stump!'

"*January 10, 1862.*—When her delirium is at its height, as well as at all other times, her right hand is rational, asking and answering questions in writing; giving directions; trying to prevent her tearing her clothes; when she pulls out her hair, it seizes and holds her left hand; when she is asleep, it carries on conversation the same; writes poetry; never sleeps; acts the part of the nurse as far as it can; pulls the bedclothes over the patient, if it can reach them, while uncovered; raps on the headboard to awaken her mother (who always sleeps in the room) if anything occurs, as spasms, etc."

"Old Stump" made no statements, so far as the account goes, about its own identity. It always spoke of the patient in the third person as "Anna," but that is common in changes of personality.

* Proceedings of the American Society for Psychical Research, vol. i, p. 552.

Dr. Barrows himself believed that "Old Stump" possessed more intelligence and knowledge than the patient ever had, but the record is not extensive enough to pronounce on that point. It seems most probable that "Old Stump" expressed what remained of the patient's sane self, which still existed, although the incoherent mass had control of the rest of her body.

In the case of successive personalities, if no memory is retained, each synthesis has to learn of the existence of the others as of third persons, and may cherish friendly or unfriendly feelings toward them. When memory is retained, if the change is not very great, the patient often expresses it by saying that he is "asleep," which is doubtless a phrase borrowed from the hypnotizer. According to Prof. Janet,* the more intelligent often say: "But I am not asleep, it is absurd to say that; only I am changed, I am queer; what have you done to me?" Rose, who has four or five states, says, "It is always I, but not always the same thing."

When the change is more extensive, the patient often hesitates or refuses to claim identity with her own past self. Leonie, another of Prof. Janet's patients, has two other states which can be evoked successively and which possibly exist simultaneously. The third, which calls itself Leonore, says of the first: "A good woman, but pretty stupid; she is not I"; while of the second state—Leontine—she says: "How can you think me like that madcap? Happily, I am nothing to her." Leontine several times wrote letters while Leonie's attention was distracted. One of these ran as follows:† "My dear good sir: I must tell you that Leonie really, really makes me suffer a great deal. She can not sleep, she gives me much trouble; I shall destroy her; she makes me dull, I am also sick and very tired. This is from your most devoted Leontine." When Leonie discovered these missives she always destroyed them, so the writer adopted the further plan of concealing them—with Leonie's own hands, of course—in a photograph album, into which Leonie never dared look, because it had once contained the portrait of Dr. Gibert, who used to hypnotize her. In short, whenever Leonie fell into a fit of abstraction, she, or at least her body, was apt to do things which bore evidence of intelligent purpose and often of wishes very much at variance with Leonie's.

Subconscious states, which exist at the same time as the upper consciousness, may cause it many perplexities. Said one patient:‡ "'I can not in the least understand what is going on. For some

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* *L'Automatisme Psychologique*, second edition, p. 130. † *Op. cit.*, p. 321.

‡ Quoted from Prof. Janet, by Mr. F. W. H. Myers, in the Proceedings of the Society for Psychical Research, vol. ix, p. 21.

time past I have been working in an odd way; it is no longer I who am working, but only my hands. They get on pretty well, but I have no part in what they do. When it is over I do not recognize my work at all. I see that it is all right; but I feel that I am quite incapable of having accomplished it. If any one said, It is not *you* who did that! I would answer, True enough, it is not I. When I want to sing, it is impossible to me; yet at other times I hear my voice singing the song very well. It is certainly not I who walk; I feel like a balloon that jumps up and down of itself. When I want to write I find nothing to say; my head is empty, and I must let my hand write what it chooses, and it fills four pages, and if the stuff is silly I can not help it.' The curious point is that in this fashion she produces some really good things. If she makes up a dress or writes a letter, she sometimes shows real talent, but it is all done in a bizarre way. She looks absorbed in her work, but yet is unconscious of it; when she lifts her head she seems dazed, as if she were coming out of a dream, and does not recollect what she has been doing. . . . Although she still has activity, she has no longer the personal consciousness of this activity, and her acts therefore can no longer be called voluntary."

I have now briefly analyzed the leading types of what is known as double or multiple personality. Successive changes of personality are demonstrated facts. That subconscious states of some sort exist is also exceedingly probable. For the existence of simultaneous personalities there is also good evidence, and in some cases I am inclined to admit it. Yet I believe that we can not be too careful in making use of these conceptions. While the evidence upon which they are based is stong, it must not be forgotten that it is largely selected evidence, that multitudes of cases remain for which these theories afford no adequate explanation, and that the metaphysical basis upon which the theory itself rests is far from finally established. While formulating theories, we must not become theorists.

RAISING bacteria for the general market is an entirely new business which a large German firm of color manufacturers has recently engaged in. They advertise that they will deliver, under the name of nitrazin, cultures of bacteria with which to inoculate various leguminous crops, to the increase of their yield and improvement of their quality. Their stock includes pure cultivations of nodule organisms suitable to the growth of seventeen varieties of beans, clover, and other crops of the family mentioned. Each bottle is labeled according to the crop for which it is intended, of which the botanical and the German name are given. Sixty-three cents will procure enough bacteria to inoculate half an acre of land.

TWO SCIENTIFIC WORTHIES.*

By HARRISON ALLEN, M. D.

WE can estimate the popularity of any branch of knowledge by the interest taken by the public in the lives of the men who are identified with it. We read with avidity the lightest details in the careers of military leaders for the glamour which is attached to war; but the victories and defeats of students of Nature pass unregarded.

The mediæval naturalist was artist and naturalist, or priest and naturalist. Permit me to quote a passage from Edward Forbes's Naked-Eyed Medusa: "The genus *Sarsia* was instituted by Lesson for a very remarkable Medusa discovered by the eminent naturalist of Norway, whose name it bears; a philosopher who, pursuing his researches far away from the world, buried among the grand solitudes of his magnificent country, where the pursuit of science is his recreation, and the holy offices of religion his sacred duty, has nevertheless gained name and fame wherever the study of Nature is followed. The unpretending writings of this parish priest have become models for the essays of learned professors in foreign lands, and his discoveries the texts of long commentaries by experienced physiologists." Father Sars, a priest and naturalist, appears to have been a representative of the mediæval type projected into the nineteenth century. While the conflict between science and religion is going on, the amenities of science and religion as exemplified by such a career should be acknowledged.

I shall sketch briefly the careers of two scientific worthies, one standing on the threshold of modern times, and the other well within. I allude to the naturalist and physician in the person of Sir Thomas Browne, and the naturalist and administrator in that of Sir Thomas Stamford Raffles. I shall present their claims as scientists, for these have been largely ignored.

Sir Thomas Browne was an English provincial physician of the time of Charles II. He was born in 1605 and died in 1682. We are informed that modern readers without special preparation can understand the spirit of this time. But we must acknowledge Browne is something of a puzzle. It is true we can dip into his mental life as we can read of an Owen. He is one of us. He thought and worked as we do. At other times he appears as a Rosicrucian in his physics—an Aldrovandus in his natural history.

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* An address delivered before the Academy of Natural Sciences of Philadelphia, December 7, 1894.

How pregnant his inquiries! How trenchant his comments! A phrase suggests the beginnings of new sciences. His phraseology is cumbersome and pedantic, yet in startling ways he will use poetical expressions in the midst of learned comments that carry the mind along vistas of the imagination. He was a physician, and, while giving only his leisure to science and literature, he became a leading authority in the zoölogy and botany of Great Britain. He introduced the word "commensality," now in com-

THOMAS BROWNE.

mon use, to express a state of many living together, as it were, at the same table. This word is mentioned by Johnson as an example of a useful term which if rejected must be supplied by circumlocution. Browne was a pioneer in the scientific study of graves and their contents. He appreciated the value of fossils. He was also a comparative anatomist, and constantly engaged in such topics as the anatomy of the horse, the pigeon, the beaver, the badger, the whale. In a note on an autopsy of a spermaceti whale the following passage occurs: "It contained no less than sixty feet in length, the head somewhat peculiar, with a large prominence over the mouth; teeth only in the lower jaw, received

into fleshy sockets in the upper. The weight of the largest about two pounds; no gristly substance in the mouth, commonly called whalebones; only two short fins . . . on the back; the eyes but small." This is a very good note, we think, and written in a scientific spirit.

He studied animal mechanism, especially the gaits of quadrupeds and the acts of swimming and floating; the problems of right and left handedness; and the erect figure of man. He tells us that "tempermental dignotions" can be detected by studying spots on the finger nails. Physicians even in our own day have not formulated knowledge on this curious subject. He discovered the animal soap now called adipocere. "He would have made a very extraordinary man for the Privy Council," we are told by his biographer.

A letter of advice to a young physician from Browne gives an estimate of the reading held to be essential to a medical course in his day. "Lay your foundation in anatomy." Among authors he recommends Vesalius, Spigelius, Bartholinus; and enjoins his friend to "master Dr. Harvey's piece, the Circulation of the Blood; also, to read with care and diligence Sennertus's Institutes. This done, to see how Institutes are applicable to practice." It must be remembered that in Browne's day "institutes" included physiology. This is all very modern in spirit.

What were the contents of a scientist's mind of the seventeenth century? The queries are taken from Sir Thomas's commonplace book. "Why little lap-dogs have a hole in their heads and often other little holes out of the place of the sutures?" "Why a pig's eyes drop out in roasting rather than other animals?" "Why a pig held up by the tail leaves squeaking?"* "What is the use of dew claws in dogs?" "To make trial of this, whether live crawfish put into spirits of wine will presently turn red, as though they had been boiled, and taken out walk about in that color." Such an experiment reminds us of the famous distich of Peter Pindar.

Here is another modern touch! Browne remarks of one of his writings: "It is done by snatches of time, as medical vacations, and the fruitless importunity of uroscopy would permit us. And therefore also, perhaps it hath not found that regular and constant style, those infallible experiments, and those assured determinations, which the subject some time requireth, and might be expected of others, whose quiet doors and unmolested hours afford no such distractions." The "importunity of uroscopy" is per-

* Charles Waterton asks, "What is the use of classification, when no one can tell us why most birds drink, by alternately sipping and raising the head between the sips, and others like the pigeon by prolonged immersion of the bill?"

haps less "fruitless" than it was in Sir Thomas's time, but physicians who chance to have scientific tastes will repeat the plaint of envy for those favored ones "whose quiet doors and unmolested hours afford no distractions."

Browne wrote in addition to scientific work two remarkable general treatises—the Religio Medici and Christian Morals; and indeed on these accounts he has been absolutely appropriated by the literary critic. It is necessary, as we have said, to secure a true point of observation in judging of the science of Sir Thomas Browne so as not to be unfair to him. It is equally necessary to resist the claim of professional authors that Browne is simply a man of letters. Mr. Simon Wilkins, in speaking of the early death of Thomas, the second son of Sir Thomas Browne, says that if he had not been cut off early, his character and talents would have secured to him in the profession he had chosen a distinction not inferior to that his father had attained in the more quiet paths of philosophy and science. But this is a single voice. It is likely that many who hear these words will learn for the first time that Sir Thomas Browne was a *savant* as well as a literary man. Because Browne took no interest in the theological and political controversies of his time, the writer of the biographical notice in the Encyclopædia Britannica calls him a psychological curiosity. Allibone in his Dictionary of Authors does not allude to his science. In Johnson's celebrated life of Browne (it is strange that with such lack of sympathy he should have written at all) occurs this passage in reference to the Hydrotophia or Urn Burial: "It is indeed like other treatises of antiquity rather for curiosity than use, for it is of small importance to know which nation buried their dead in the ground, which threw them into the sea, or which gave them to the birds and beasts; when the practice of cremation began, or when it was disused; whether the bones of different persons were mingled in the same urn; what oblations were thrown into the pyre or how the ashes of the body were distinguished from those of other substances." We are properly instructed to bow before the great moralist and thinker, Samuel Johnson; but for such an estimate as the above (and it is by no means an isolated one in which Johnson held all knowledge of the exact sciences) we can not be alone in confessing to some impatience!

No more striking figure is met with in modern biography than that of Sir Thomas Stamford Raffles. He was the first to give the learned world knowledge of the mysterious East as expressed in Java and Sumatra. He, like Sir Thomas Browne, has been strangely misjudged by the literary critic.

Raffles was born in Jamaica in 1781, but was educated in Eng-

land. He was the only surviving son of Benjamin Raffles, one of the oldest captains in the West Indian trade at Port London. His school education ceased at the early age of fourteen years, when he was removed from the seminary and placed as extra clerk in the East India House. He never overcame the deficiencies arising from imperfect early education. The habit of study which in after years made him remarkable for his attainments was due to utilizing the moments which he described as "stolen" either before office hours or after them in the evening.

THOMAS STAMFORD RAFFLES.

In 1805 the Court of Directors determined to make an establishment at Penang, a small island on the west coast of the Malacca Peninsula. Raffles was appointed assistant secretary to Sir Hugh Inglis, the representative of the Court of Directors in the East India Board. He was at this time but twenty-four years of age. In 1811—namely, when he was thirty years of age—he was appointed by the directors agent to the governor-general. He suggested to the Indian Government the conquest of Java, and after this was accomplished in 1811 he was appointed lieutenant-governor.

The Spice Islands, so called because they yielded cloves, nutmeg, coriander, mace, ginger, pepper, and cinnamon, were so important to Europe that their possession was eagerly sought for by the maritime powers. As condiments the demand for many of the spices is much less now than formerly was the case. The esteem in which ginger and pepper especially are yet held is low in comparison with that entertained in the period from the fifteenth to the beginning of the present century. Are the relatively few dishes into which these spices enter to be regarded as survivals of

the diet of a Charles V ? Is the art of cooking so far advanced that we are no longer obliged to cover up taint with aromatics ? But after answering such questions, and after making allowance for changes in taste, it is a striking fact that spices should at any time have entered into questions of state policies.

As an antithesis to an active life Herrick says of a rustic hero :

> Thou never plow'st the ocean's foam
> To seek and bring rough pepper home,
> Nor to the Eastern Ind dost rove
> To bring from thence the scorchèd clove.

Was not the zest to control spice due to its use, not as a condiment as it is with us, but as a preservative ? Ice appears to have had a small place in preserving perishable articles. Salt is a coarse agent and impairs both the flavor and digestibility of food when used in sufficient quantity to arrest decomposition, and with the exception of the olive is not applicable to fruits. Spices are highly antiseptic. Oil of cloves is used by microscopists in preserving sections of tissue. Oil of cinnamon is one of the most valuable antiseptics in the modern materia medica. Spices increase the preservative power of sugar, an article of luxury in the middle ages and far out of the reach of the masses. If this view of the importance of spices be conceded, we can understand their value as something over and above their use to improve a defective *cuisine,* increase flavor, and add variety to diet. We must also remember that while the attempts to find new routes to the Spice Islands by sailing west failed, the early voyagers discovered in the American tropics vast tracts of arable land which were adapted to the growing of many of the spices; they also succeeded in bringing to the European market new condiments in capsicum and allspice. Besides this, rapid transportation places fresh fruit early in the market, and the discoveries of chemistry have done away with the necessity of resorting to spices for preservatives, benzoic acid alone supplanting most of them in the keeping of vegetable products. Thus geographical and chemical sciences have brought about changes in national policy.

While no future administrator is likely to repeat the experience of a Raffles in giving excuse for European control of the Spice Islands, the rôle that he played was one but little less in importance to the East (especially in Java) than that of the Dutch administrators who preceded and followed him.

Raffles secured Singapore in 1818, and thus transferred to British interests the waters by which the best passage from the Indian seas to the Pacific Ocean is possible. His opportunity came with the Napoleonic wars, by which the loss of Holland to the French

threw the Eastern possessions of the Dutch as fruits of conquest into the hands of the English.*

Raffles encouraged missionary work, and in 1821 endeavored to suppress slavery in the island of Pulo Nias. The circumstances attending this traffic were no less revolting than those that marked it on the coast of Africa. But the East India Company was an association of traders, and prudently repressed whatever sentiments its members may have held on the subject of slavery. The Court of Directors disapproved of Raffles's acts, and went so far as to assert officially that his proceedings were deserving of their reprehension. He always insisted that it was folly to assume that the exposure of the evils of the slave-system in any way affected the Company. However, he came near being dismissed from the service, and in a little while after the transfer of the islands to the Dutch the slave trade was resumed with greater vigor than ever. I mention this circumstance in order to show how differently Raffles interpreted his duties from those of a mere agent of a trading company. He held science, literature, and practical benevolence as primary motives to action.

But, by the redistribution of lands agreed on at the Congress of Vienna in 1815, Java ("another India!" cries a despairing critic) was returned to the Dutch; and the Raffles administration (and to a great extent the reforms he established), after a brilliant term of five years, came to an end.

After his recall from Java, he visited England. The Prince Regent showed his appreciation as opposed to that of the East India Company by knighting Raffles, and in a short time thereafter appointing him Lieutenant-Governor of Sumatra.

Any sketch of Raffles would be incomplete that did not include an account of his domestic life. He married in 1805, but lost his wife in 1815. He remarried in 1816. Lady Raffles, in 1830, wrote a life of her husband in the form of a large quarto of exactly eight hundred and twenty-three pages.† Judged by the standard of the taste of to-day, such an achievement defeats in great measure its own object, though it must be said in behalf of the author that she intended the volume to be a defense of her husband's services, and the records of his private life are subordinated.

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* A study of the influences of the Raffles administration over Philadelphia would be found interesting. The founding of Penang and Singapore gave increased security to our vessels trading in the China seas. The Raffles and, later on, the Brookes policy tended to suppress piracy. The large trade of Philadelphia with the East in the early part of this century, that built up the fortunes of a Girard and a Wagner, has been of incalculable advantage to Philadelphia.

† Memoir of the Life and Public Services of Sir Thomas Stamford Raffles, F. R. S. London, John Murray, 1830.

Raffles's domestic life and his zeal for natural history are inextricably mixed. His residence and the yard attached thereto were a museum and laboratory. "I have thrown politics far away," he writes, "and, since I must have nothing more to do with men, have taken to the wilder but less sophisticated animals of our woods. Our house is on one side a perfect menagerie; on another, a perfect flora; here, a pile of stones; there, a collection of seaweeds, shells, etc."

When he was in Bencoolen he rose early, and delighted in driving into villages, inspecting the plantations and encouraging the industry of the people. At nine the family assembled at breakfast; afterward he wrote, read; studied natural history, chemistry, and geology; superintended the draughtsmen (of whom he had constantly five or six employed), and always had his children with him as he went from one pursuit to another. At four he dined, and seldom alone. After the party had dispersed, he was fond of walking out with the editor (Lady Raffles always alluded to herself as the editor), and enjoying "the delicious coolness of the night land-wind." "I believe people generally think I shall remain longer," says he in a letter to a friend, "as they hardly suppose in such times, and with an increasing family, a man will be inclined to forego the advantages of the field before me; but they know me not. I have seen enough of power and wealth to know that, however agreeable to the propensities of our nature, there is more real happiness in domestic quiet and repose, when blessed with a competence, than all fancied enjoyments of the great and the rich" (page 497). His oldest son Leopold "has the spirit of a lion, and is absolutely beautiful." His daughter Charlotte "is of all creatures the most angelic I have ever beheld." There are two other younger children, Harry and Ella. But Sumatra, as indeed all tropical Asia, excepting favored localities in Java, is fatal to children of European parents. Raffles entertained a scheme of removing his family to a colder climate, but he lingered too long, and all his children, save the youngest, Ella, died within one year. From these blows he never recovered. His health rapidly failed. He asked to be relieved from duty, and after a foreign service of twenty years he prepared to return for good to England.

His collections included objects of natural history in every department, a living tapir and many birds, and upward of two thousand drawings, notes, observations, together with memoirs, vocabularies, dictionaries and grammars of native languages. Just as he is about to sail, all his collections being carefully stored in the hold, the vessel, through the carelessness of the steward, takes fire and everything is lost. How unutterable the dismal sense of failure that thus often awaits the explorer! Rafinesque, Wallace,

Schweinfurth, all lose the result of years of toil and privation. Humboldt makes three collections, travels with one, never losing sight of it, ships the other two, and both through the fortunes of war are in great part lost. Raffles staggered to his feet after this crushing blow and obtained a second collection with which he sailed to England. Upon his arrival he was not idle. He interested himself in establishing the Zoölogical Society of London and became its first president. He founded the Museum Rafflesianium, which is composed of specimens of natural history from the Malayan Archipelago. He died suddenly in 1826, at the comparatively early age of forty-five years.

The career of Raffles is thus briefly outlined. If any one is interested in the subject and looks it up in the Biographical Dictionary, the encyclopædias, or in articles on Java, he will find nothing, or next to nothing, on Raffles's scientific labors. The interesting chapter in Chambers' Miscellany entitled Sir Stamford Raffles and the Spice Islands relates almost entirely to his work as a philanthropist and administrator. Yet his influence on the subject of topography, botany, zoölogy, ethnology, and archæology of the East is as great as are his political ideas. He undertook systematic investigations of Java, Sumatra, and the neighboring islands. He encouraged collections to be made by competent explorers,* instituted special expeditions for collecting antiquities by which the Hindu influence on the Javanese mythology, history, and literature was established. He wrote an elaborate history of the island. Some idea of the comprehensive plan of his labors and of its rich results can be obtained by the estimate of the cargo with which he stored his ship on his departure for England.

We acknowledge the justness of the tribute to Raffles as ex-

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* The Americans who have made impressions in European affairs are naturally very few. The mind in this connection reverts to Ledyard and Count Rumford among scientists; to West, Copley, and Leslie among painters. I infer that few Philadelphians recall that a man trained in their city and a native of Bethlehem, Pa., should be added to the list. I allude to Dr. Thomas Horsfield, the most prominent of the naturalists encouraged by Raffles in the exploration of the Malayan Islands under his administration. Horsfield was born in 1773; he studied medicine at the University of Pennsylvania, where he was graduated in 1798, writing on Rhus Poisoning, which appears as one of the Medical Theses, edited by Charles Caldwell, Philadelphia, 1805. In no other publication is there to be found so excellent an account of the properties of the American poison vine and poison oak. Immediately after graduation Horsfield went to Java, where he remained for twenty years in the service of the East India Company. At the end of this time he was recalled to London, where he spent the rest of his life as the curator of the museum of the company in Leadenhall Street. He was elected a correspondent of the Academy of Natural Sciences of Philadelphia in 1826. He was the author of the classical work on Zoölogical Researches in Java, a separate volume on the rare plants of Java, as well as a special report on the annelids of the same general region. Dr. Horsfield died in 1859.

pressed in the epitaph on a tablet in Westminster Abbey. It reads as follows: "He was ardently attached to science; he labored to add to the knowledge and enrich the museums of his native land."

A DOG'S LAUGH.

By M. le VICOMTE D'AIGLUN.

ALPHONSE KARR has said: "Man is the gayest of animals; much more, he is the only gay one, the only one that laughs." Toussenel is equally explicit: "Laughter is a characteristic faculty of man." Gratiolet observes that "when man freely breathes a pure air, fresh and uncontaminated, his mouth dilates slightly, his upper lip reveals more or less of his upper front teeth, and the corners of the mouth gracefully elevate themselves; the muscles that determine this movement act at the same time upon his cheeks and raise them, slightly lifting the outer angles of his eyes, which become a little oblique. This movement of easy respiration is called the smile; and the smile of the lips is distinguished in language from the smile of the eyes. The smile of the eyes is in man, however, consecutive to the service of the mouth, and does not depend upon any special muscle. No mammalian animal has the smile of the mouth; but the smile of the eyes exists in the carnivorous animals, and, as it can not depend upon the buccal smile, its determining cause resides in a small muscle that acts on the outer angle of the eye. Dogs, it is known, have this smile of the eyes in a superior degree."* Further, he says: "The real and simple smile—that is, the movement that lifts the angle of the mouth—is exclusively peculiar to the human species. There is nothing like it even in the highest monkeys. Among the carnivores, animals of the genera *Ursus* (bear), *Canis* (dog), and

Fig. 1.—Fox Terrier Laughing.
From a photograph.

* Gratiolet. De la Physionomie, p. 25.

Hyæna have some movements that resemble the smile, but can not be really compared with it. Below the mammalian animals there is no longer mobility in the face, and consequently no longer a possible smile." *

Darwin also admits a sort of smile in dogs,† but regards it as a simple grimace: "A pleasurable and excitable state of mind, associated with affection, is exhibited by some dogs in a very peculiar manner; namely, by grinning. This was noticed long ago by Somerville, who says:

> "And with a courtly grin the fawning hound
> Salutes thee cow'ring, his wide op'ning nose
> Upward he curls, and his large sloe-black eyes
> Melt in soft blandishments and humble joy.
> —*The Chase*, Book I.

Sir W. Scott's famous Scotch greyhound, Maida, had this habit, and it is common with terriers. I have also seen it in a Spitz and in a sheep dog. Mr. Rivière, who has particularly attended to this expression, informs me that it is rarely displayed in a perfect manner, but is quite common in a lesser degree. The upper lip during the act of grinning is retracted as in snarling, so that the canines are exposed, and the ears are drawn backwards; but the general appearance of the animal clearly shows that anger is not felt. Sir Charles Bell‡ remarks: 'Dogs, in their expression of fondness, have a slight eversion of the lips, and grin and sniff amid their gambols in a way that resembles laughter.' Some persons speak of this grin as a smile, but if it had been really a smile we should see a similar though more pronounced movement of the lips and ears when dogs utter their bark of joy; but this is not the case, although the bark of joy often follows a grin."

Notwithstanding my profound respect for the names of Darwin and the other authors from whom I have quoted, I take the liberty of remarking that it is hard to laugh and bark at the same time, and that some dogs employ laughter to express their joy while at the same time wagging their tails and exhibiting all the other signs peculiar to their kind.

We must not push the analysis too far, for fear of going beyond the truth. Laughter to everybody is nothing else than a joyous expression of the face given by the movement of the mouth. No one certainly would take the trouble to find, in order to know it, by what muscles it is produced.

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* Gratiolet. De la Physionomie, p. 169.

† The Expression of the Emotions in Man and Animals, p. 120.

‡ The Anatomy of Expression, 1844, p. 140.

Now, is not that a good laugh, quite free and affectionate, that is represented in the picture, Fig. 1, taken from the instantaneous photograph of a little fox-terrier bitch in my possession, which puts on this expression very prettily every time it would manifest pleasure or a great joy? Fig. 2 gives also the expression of a dog laughing all over. It is the portrait of a collie bitch. The animal has a very pleasant physiognomy. The French language has an expression, *canin*, for canine laughter, which the dictionaries define by saying that it is produced by the contraction of the canine muscle, or the muscle that lifts the angle of the lips; and they give it as the synonym of *sardonic* laughter, because it is produced on only one side of the mouth. Fig. 1 shows that this synonymy is not always just.

FIG. 2.—A COLLIE "LAUGHING ALL OVER." From a photograph.

A friend of mine has a terrier which also laughs, and which has after a few months taught a spaniel, its habitual companion, to laugh.

This education of one animal by another is not so rare as might be supposed. I knew a little dog in Havana, a great friend of the cat of the house, that took from it the habit of moistening its paws with its tongue and washing its face with them.—*Translated for the Popular Science Monthly from La Nature.*

THERE is a good deal of human nature in the reason which General Sir Thomas Gordon gives in his Persia Revisited as having been assigned by a mollah of that country for opposing education. "They will read the Koran for themselves," he said, "and what will be left for us to do?"

POPULAR SUPERSTITIONS.

By WALTER JAMES HOFFMAN, M. D.

PRIMITIVE man fills his world with innumerable spirits, both good and bad, and much of his time is spent in devising means whereby he may invoke the aid of one class to assist him in averting the malignant influence of the other. The dread and wonder excited by the phenomena of the elements, or the discovery of anything abnormal, either animate or inanimate, suggest to his mind the existence and manifestation of deities. As the burrowing of the mole is observed to cause ridges upon the turf, so a mythic gigantic mole traverses beneath the earth to form the mountain range. The storm is caused by a monster bird, the movements of whose wings produce the winds and whose voice is heard in the muttering thunder and lightning flash. So, in everything, he recognizes the presence of some one or more beings, the pretended explanations of whose functions and exploits form the basis of his mythology. The emotions with which these deities are regarded, the dread or reverence in which they are held, and the impressions resulting therefrom, give rise among different peoples to various religious beliefs or cults.

Among civilized nations we perceive evidence of an inherent tendency to regard with partiality anything strange or unusual, the soil of the mind being prolific in the cultivation of morbid fancies which, if given serious thought, become difficult to eradicate.

The survival in America of Old-World customs, beliefs, and superstitions is naturally to be expected because of the continuity of the peoples with whom they originated. This is illustrated by the occurrence of African demonology among the negroes of the South, of Gallic folklore among the creoles of Louisiana, of some vestiges of quaint old English customs and superstitions in New England, and particularly in the survival of Teutonic folklore among the descendants of the early German colonists.

It is not surprising, then, at this late day, that the folklore and superstition of one part of the country may have been transported into another, and there taken root and become incorporated as original. No matter how little or how much change may have occurred in its transmission, or to what extent a new environment may have influenced it, the nationality of such belief or superstition may still be ascertained with tolerable certainty, as the collection and classification of such data have been reduced to a science.

As pertains to the status of the early cults of northern and western Europe, Germany holds a middle place. Our knowledge

of the religion and heathen doctrines of the Greeks and Romans rests upon writings which existed previous to the rise of Christianity. The Teutonic races forsook their ancestral faith slowly, the transition lasting from the fourth to the eleventh century. Christianity was not popular; the faith was clothed in a new language, and it aimed at supplanting the time-honored indigenous gods, and their worship was an important part of the people's traditions, customs, and constitution.*

One of the most conspicuous characteristics of the Teutonic race is a devout attachment to ancestral customs and beliefs, a trait which among the less intelligent and truly illiterate becomes proportionately intensified. It is more than probable that to this trait may be attributed the preservation of fragments of myths and folklore, as well as remarkable adherence to old-world formulæ relating to witchcraft and folk medicine, relics of customs and superstitions which are probably contemporary with the birth of the human race itself.

We are all familiar with the custom of having eggs served at Easter breakfast, and also that of children receiving presents of dyed eggs; sometimes toy rabbits or hares, made of soft, fluffy goods and stuffed with cotton or sawdust, were also given as presents. Children were told that the hare laid the eggs, and nests were prepared for the hare to lay them in. The custom obtains as well in South Germany. The figure of a hare is placed among the Easter eggs when given as a present.

The association of the hare with Easter observances was much more common in former times, and in England it was customary for the hare to be eaten at such times. Hare-hunting as an Easter custom began to fall into disuse about the middle of the last century.

The use of eggs as a sacred emblem of the renovation of mankind after the Flood was held by the Egyptians, and the Jews adopted it to suit the circumstances of their history as a type of their departure from the land of Pharaoh. The egg suggests a resurrection to life of a vital principle which may for an indefinite period have lain dormant. Hutchinson, in his History of Northumberland, says:

"It was used in the feast of the Passover as part of the furniture of the table with the Paschal Lamb. The Christians have certainly used it on this day as retaining the elements of future life for an emblem of the resurrection. It seems as if the egg was thus decorated for a religious trophy after the days of mortification and abstinence were over and festivity had taken place; and as an emblem of the resurrection of life, certified to us by the

* Grimm. Teutonic Mythology.

resurrection from the regions of death and the grave."* "The Church of Rome, also, in the time of Pope Paul V, considered eggs emblematical of the resurrection." †

Germans to this day term April *Ostermonat*, or Easter month, an old form of the word *óstarmânoth* occurring as early as the time of Charlemagne. The Old High German name was *óstarâ*, the plural form being retained, as two days were usually kept at Easter. The association of the hare with eggs is curious, and the explanation is found in the belief that originally the hare seems to have been a bird which the ancient Teutonic goddess Ostara turned into a quadruped. For this reason the hare, in grateful recognition of its former quality as a bird and swift messenger of the Spring Goddess, is able to lay eggs on her festival at Easter time. ‡

The practice of nailing a horseshoe against the lintel of a door is familiar to almost everybody; and it is thought particularly efficacious in warding off bad luck if the shoe be one that was found upon the highway.

Although this custom obtains more extensively among the negroes, it is not of African origin. I am inclined to believe that it originated at a time more remote than the superstitions relating to "thirteen at a table," or "the spilling of salt," both of which are generally conceded to have originated at or with the Lord's Supper and consequent events.

The Romans drove nails into the walls of cottages as an antidote against the plague; for this reason L. Manlius, A. U. C. 390, was named dictator to drive the nail.# In Jerusalem, a rough representation of a hand is marked by the natives on the wall of every house while in building. ‖ The Moors generally, and especially the Arabs of Kairwân, employ the marks on their houses as prophylactics, and similar handprints are found in El Baird, Petra. General Houtum-Schindler, of Teheran, informs me that a similar custom exists in Persia, as well as in parts of northern India.

That these practices and the later use of the horseshoe originated with the rite of the Passover is probable. The blood upon the doorposts and upon the lintel (Exodus, xii, 7) formed, as it were, an arch, and when the horseshoe was subsequently observed as resembling, conventionally, a similar arch, it may naturally have been adopted, and in time become a symbol of luck, or "safety," to those residing under its protection.

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* Quoted by Brand. Observations on Popular Antiquities. London, 1877, pp. 90, 91.

† Ritual of Pope Paul V, for the Use of England, Ireland, and Scotland; quoted by Brand, *op. cit.*, p. 91, note.

‡ Folklore Journal. London, vol. i, 1883, p. 123.

Lieutenant Condors. Palestine Exploration Fund, January, 1873, p. 16.

‖ Brand. Antiquities. London, vol. iii, 1882, p. 18.

Beliefs and superstitions relating to snakes are exceedingly common. These reptiles, by their graceful and sinuous movements and the terror of their bite, appear at once to command reverence and awe. The worship of the tree and the serpent was a cult of aborigines of India, the Turanians; and evidences of ophilolatry, or snake worship, appear in other parts of the world. Kneph, the grand serpent of Egypt, is the father of Hephæstus, the god of metals; and Hi, the serpent god of Chaldea, the master of all wisdom, is also guardian of treasures.* In the mythology of several peoples of the Old World the serpent is associated with the guardianship of golden treasures and mines. The god serpent of Greece, Cadmus, was regarded as the first miner, and he was, according to Pliny, the first workman in gold.†

Stories are extant of an exchange of form between human beings and snakes, an interesting example of which was at one time currently reported in South Whitehall, Lehigh County, Pennsylvania. Further reference to this will be made presently.

A very common belief is to the effect that if one kills the first snake met with in the spring, no others will be observed during the remainder of the year. In Swabia, tales are still told of home snakes which appear to bring good luck, but which must under no circumstances be killed. These snakes come to the children and sip milk with them out of their bowls. Tales of this class were common a score of years ago, and I remember hearing of a child eating bread and milk from a saucer, while a huge black snake drank freely from the same dish, but at short intervals the child would playfully tap its spoon upon the snake's head, saying, "Du musht me^{n} mŏk'ka fres'sa," to cause it to drink less milk and to eat more of the bread.

Occasionally we hear of black snakes found in pastures where they suckle cows, so that these animals daily resort to certain localities to secure relief from a painful abundance of milk.

Some of these house and farm snakes wear crowns, and are then termed king snakes. Such were reported from several localities in Lehigh County, one of which was said to abide in a large pile of rocks near Macungie. It was seldom, however, that this golden-crowned serpent was seen; still, the greater number of residents thereabout were firm believers in the truth of the report.

As an illustration of the belief in the transformation of human beings into serpents, I will relate a circumstance said to have occurred during the first half of the present century. Near Trexlertown, Lehigh County, dwelt a farmer named Weiler. His wife and three daughters had, by some means or other, incurred the

* Jones. Credulities Past and Present. London, 1880, pp. 120, 121.

† Jones. *Op. cit.*, 121.

enmity of a witch who lived but a short distance away, when the latter, it is supposed, took her revenge in the following manner: Whenever visitors came to the Weiler residence, the girls, without any premonition whatever, would suddenly be changed into snakes, and after crawling back and forth along the top ridge of the wainscoting for several minutes they were restored to their natural form. This curious transformation occurred quite frequently, and the circumstance soon attained widespread notoriety. About the end of the third month the spell was broken and everything went on as before.

Another popular fallacy is the existence of the hoop snake. This creature is usually reported as capable of grasping the tip of its tail with its mouth, and like a hoop running swiftly along in pursuit of an unwelcome intruder. This snake is believed, furthermore, to have upon its tail a short, poisonous horn, like a cock's spur, and that if it should strike any living creature death would result. The stories concerning this marvelous snake usually end with the statement that the person pursued barely escapes, and that the snake strikes a tree instead, causing it to wither and die.

The rattlesnake, because of its venomous bite, is universally dreaded, and numerous curious beliefs are current respecting this reptile, also the use to which various parts may be put, and the treatment of its bite.

The rattle, if tied to a string and suspended from the neck of an infant, will serve to prevent convulsions; if carried by an adult, it will guard against rheumatism. The oil is employed as a remedy for deafness; and the venom, diluted, mixed with bread, and made into pills, has been administered internally to cure rheumatism. Another curious superstition, held by young men, is that if one places a snake's tongue upon the palm of his hand—beneath the glove—it will cause any girl, regardless of her previous indifference, to ardently return his passion if he be enabled but once to take her hand within his own. This resembles to a certain extent the former use, in Germany, of a dove's tongue, which was similarly employed; and furthermore, if one became aware that the choice of his heart failed to respond to his affection, he had only to place a dove's tongue within his mouth and snatch a kiss, when the girl's objection or indifference to him would instantly vanish.

There are numerous popular methods of treating snake bites, from the internal use of alcoholic liquors to the external application of warm, raw flesh obtained by cutting a live chicken in two.

I ascertained a short time since the secret of alleged success claimed by various mountain powwows both in Pennsylvania and in Maryland. The remedy is termed the *Meisterwurzel*, or "master

root," commonly known as the *sanicle*, or *Sanicula marylandica*. The roots of the plant are crushed, one part being made into a poultice and applied to the wound, while the remainder is boiled in milk, which is freely administered internally.

The following procedure was formerly practiced in northern Lehigh County, and obtains even at this day in Cumberland County. The operator recites the following words:

Gott hott alles ärshaffa, und alles wâr gūt;
Als dū alle", shlañg, bisht ferflucht,
Ferflucht solsht du sai" und dai" gift.

God created everything, and it was good,
Except thou alone, snake, art cursed;
Cursed shalt thou be and thy poison.

The speaker then with the extended index finger makes the sign of the cross three times over the wound, each time pronouncing the word *tsing*.

In connection with the extraction of serpent venom may be mentioned the use of the snake stone or mad stone, the latter without doubt having originally been employed in snake bites.

The earliest notice of stones used in extracting or expelling poisons occurs about the middle of the thirteenth century, though the knowledge of them and their use by the superstitions of Asia Minor appears to antedate that period. They are called bezoar stones, from the Persian *pad-zahr*, signifying to expel poison. This substance is a calculus or concretion found in the intestines of the wild goat of northern India known as the *pazan*. Various other ruminants also possess similar concretions, but the Oriental variety seems always to have been the more highly prized and entered largely into various therapeutic remedies two centuries ago.

In addition to the fact that the fable of poison-extracting stones may be traced back to the middle ages, and that they had been used long anterior to that time in Asia Minor, it is more than probable that a knowledge of their reputed properties and possibly specimens were brought back to Europe by crusaders on their return from the Holy Land.

Several objects found in 1863 at Florence, on the site of the old church of the Templars, dedicated to St. Paul, may be briefly noticed. One of these was a vase and another a medal. Among other figures upon the vase is one of St. Paul bitten by a serpent, and the Latin inscription signifying, "In the name of St. Paul, and by this stone, thou shalt drive out poison." On the other side is engraved in relief the cross of the temple between a sword and a serpent. On the medal is represented a dragon with an Italian legend signifying, "The grace of St. Paul is proof against any poison."

That St. Paul is the one appealed to in the above instances may be attributed to the fact that he was not affected by the bite of a serpent when almost instant death was the result expected by his associates (Acts, xxviii, 3–6).

It would appear that the Old-World custom of employing calculi or stones for the extraction of serpent venom gradually led to the practice in modern times of applying similar substances to wounds made by the bite of rabid dogs. These calculi are of a cretaceous or chalky nature, and anything of a cretaceous character may, if dry, possess absorbent properties; and it is probable that to this property may be attributed the first employment of the Oriental bezoar stones as capable of extracting or expelling poisons.

The prescription for the use of the so-called mad stone is generally as follows: Place it against the wound until it becomes saturated with the poison, when it will of its own accord fall off. Then boil it in milk to remove the poison, and repeat the application until the stone refuses to adhere.

A short time since I examined a celebrated North Carolina mad stone, one that had widespread reputation. This stone was of the size and form of an ordinary horse-chestnut, white in color, and consisted of feldspar, a hard mineral usually found in granite. It possessed no absorbent properties whatever, and its reputed ability to extract poison or any other liquid was utterly unworthy of a second thought.

We are all familiar with the frequently circulated reports of the cures performed by mad stones, reports pretending to emanate from reputable physicians and others, but when we attempt to trace the source from which they emanate they are found to be of questionable authority.

To illustrate the esteem in which these substances are held, I will only add that in 1879 a mad stone was sold to a druggist in Texas for two hundred and fifty dollars. The specimen was found in the stomach of a deer.*

It may be of interest to refer to a famous specimen, known as the "Lee" stone or penny,† which consisted of a small, heart-shaped pebble of carnelian or agate, set in a silver coin about one inch in diameter. The specimen was traditionally asserted to have been brought from the Holy Land, and it is said to have suggested to Sir Walter Scott the design of his Talisman. According to the legend, Robert Bruce wished that after his death his heart should be carried to the Holy Land by Sir James Douglas; and in 1329 the latter, accompanied by Simon Lochart, of the Lee, proceeded on the mission. In Spain the Scots were

* Journal of Chemistry, Boston, 1879.

† Jones. *Op. cit.*, p. 330.

drawn into a combat with the Moors. Douglas was killed, and Lochart, who now commanded the party, turned homeward with Bruce's heart, which was eventually buried in the Abbey of Dunfermline. Lochart (changing his name into Lockhart, to commemorate the event) had taken prisoner a Moorish chieftain, and the wife of the prisoner when she bargained for the husband's ransom, while counting the gold from her purse, let drop this gem, and appeared so anxious to recover it that Lockhart insisted upon its being made a part of the ransom. The woman unwillingly consented, and informed the greedy Scot that its value consisted in its power of healing cattle, and that it was also a sovereign remedy against the bite of a mad dog. So great was the popular faith in this talisman in Scotland that the Lee penny was exempted from anathema in the clerical war against superstitions after the Reformation, and the clergy went so far as to extol its virtues, in which implicit faith was placed until a comparatively recent period. The mode of using this amulet was to hold it by the chain, and then plunge it three times in water, and once round—*three dips and a swell*, as the country people expressed it; the cattle drinking the water were cured. In the reign of Charles I, the people of Newcastle being afflicted with the plague, sent for and obtained the loan of the Lee penny, leaving the sum of six thousand pounds sterling in its place as a pledge. For this sum the Laird of Lee, the owner, would not part with it. It is reported also that about the beginning of the last century Lady Baird, of Saughton Hall, having been bitten by a mad dog, and exhibiting all the symptoms of hydrophobia, her husband obtained a loan of the amulet, and she having drunk and bathed in the water in which it was immersed, was cured of her malady.

Many other interesting examples of superstitious practices might be given, some of which have been handed down from remote antiquity, while others are of comparatively modern date and probably the result of circumstances and environment. The use of the staff and rod in divination was known to the ancient Jews, and Hosea reproached them for adhering to the superstition. Tacitus mentions this sort of divination as a custom of the ancient Germans.

We are all aware of the frequency with which the divining rod is used in the search for water, ores, and hidden treasure; and we learn occasionally of certain individuals claiming to possess the power of curing sickness and healing wounds by the mere laying-on of hands; of exorcising evil spirits, and combating the spells of rival witches; laying ghosts and giving charms and amulets, and pretending, in fact, to be able to accomplish almost anything that may be desired.

Who has not heard of carrying a potato, or a horse-chestnut,

to ward off rheumatism; having secreted somewhere about the person the left hind foot of a graveyard rabbit for luck; or placing within the purse the dried heart of a bat for success in gambling?

Many mothers believe that amber beads possess signal properties in curing their children of sore eyes, ears, or throat; while the flannel band to be worn about the neck to cure tonsilitis or an inflamed throat must be red, as that color corresponds to the color of the malady. In like manner the carrot is held in esteem in the cure of jaundice, yellow being the characteristic color of both. The carrot is suspended in the room occupied by the sufferer, and as the root shrivels and dries up the affection is removed. Warts, it is believed, may be removed by rubbing upon them a piece of meat which is then buried; as the meat decays the warts go away. They may also be transferred to another by rubbing upon them a piece of bone, and putting this upon the spot where found; whoever picks up the bone will have the warts transferred to his own hands.

We are all more or less uncomfortably impressed at hearing unaccountable noises; many persons dread going upon a journey or cutting out a garment on Friday. Thus we perceive that the mere reference to the trifles which are apt to control our actions brings to our minds such a startling array of superstitions, observed by us in others, or perhaps even entertained by ourselves, that it becomes impracticable to continue further entering so prolific a subject at this moment.

I may say, in conclusion, that it is only by exposing such fallacies that we can hope for their extinction; but this is no easy matter, remembering the axiom that "there is no truth, however pure and sacred, upon which falsehood can not fasten and ingraft itself therein."

THE birth of a child among the Bondei people of Africa is attended, according to the account of the Rev. G. Dale, missionary, by many great perils, for if a single condition regarded as unfavorable occurs, the infant is strangled at once. Its life is in danger again at the time of teething, for it may be so incautious as to let its upper teeth protrude first, and if this is the case it is held unlucky, and will almost certainly be killed. Even if it is allowed to live it will be in perpetual danger, and any disaster that happens to its parents will be attributed to it. If, however, the under teeth protrude first, the child's moral character is established. The boy can not, however, enter the house in which the unmarried men sleep till he has been publicly welcomed. For this ceremony all the boys and girls assemble, and the father brings the child out to show them that the lower teeth have protruded first. Then every house contributes Indian corn, and the children pound and eat it, after which the boy is regarded as one of them.

SCIENCE IN WHEAT-GROWING.

By M. P. P. DEHÉRAIN.

THE chlorophyll cells and the leaves of the plant may be regarded as little laboratories elaborating vegetable matter; they work upon the carbonic acid, which the enormous quantity of water they contain enables them to extract from the atmosphere, reduce it, and form with the residue from its decomposition, after the elimination of oxygen, sugars and cellulose, straw-gum, vasculose, and all the ternary matters composed of carbon, oxygen, and hydrogen; these cells likewise reduce the nitrates which are brought to them at the same time with phosphoric acid, potash, and silica, by the water which constantly traverses the plant, entering it at the root and being exhaled from the leaves.

If rain is frequent and the soil well moistened, the cells will continue their work for a long time; they will elaborate much vegetable matter, and the plant will grow. But the course is not the same if rain is scarce and the soil is parsimonious in providing for the enormous expenditure of water which the wheat makes. I have found that a leaf of wheat exhales, under one hour of insolation, a weight of water equal to its own. When the earth, insufficiently watered by rain, becomes incapable of supplying this prodigious consumption, desiccation of the organs is produced, and it is always the oldest leaves which dry up and perish first. A May rarely passes without one seeing the little leaves fixed at the base of the stem soft, flabby, and withered. If we submit them to analysis, we find that they have let escape some nitrogenized matter, phosphoric acid, and potash, which they contained while they were living, green, and turgescent. It is well to lay stress upon this death of the leaves, and on the departure of the materials they contain; when the leaf dies, one of the small agglomerations of working cells is closed, the quantity of matter elaborated is then less than if it had continued its task, and as the closure of these little laboratories is determined by their desiccation, we conclude that the quantity of vegetable matter formed during dry years is limited, and that the stems are shortened and there is little straw.

At the moment when desiccation begins the nitrogenized matter which forms the protoplasm, the living part of the cell, is metamorphosed, and takes an itinerant property that permits it to pass through the membranes and migrate toward the new leaves, carrying with it its usual accompaniment of phosphoric acid and potash. This transportation of some of the elaborated material from the lower leaves toward the upper leaves goes on through

the whole duration of vegetation, and continues at the time of flowering, which, without doubt, by a mechanism of which we do not know the method of operation, takes place only when the quantity of materials elaborated is sufficient to nourish the seeds which are about to appear.

The wheat begins to head, in our latitude, early in June. On pressing lightly between the fingers the upper part of the stem, at the place where it appears a little swollen, we meet a slight resistance, due to the head, which is entirely formed before it emerges. It is composed of a stem; the rhachis, which bears the flowers, formed of little green leaflets; and the glumes, one of which terminates, in some varieties, in the long appendage characteristic of bearded wheat. If, at the moment when the head emerges outside of the stem, we gently lay open the glumes, we shall discover the essential organs of the flower within. On a little greenish swelling, the rudiment of the corn, are fixed two little aigrettes of plumes, slightly divergent. These are the pistils, the female organs. Around them, fixed at the extremity of fine peduncles, are the anthers, as yet closed. They contain the pollen, the yellow fecundating dust. At the moment of maturity the anthers open and the pollen falls on the little plumes of pistils, well constructed to hold it. It germinates there, sends out a long tube—the pollinical branch—into the ovule, to which the plumous pistils are attached. Fecundation is accomplished, and the corn is formed.

All these delicate operations, which it is so interesting to follow, take place in the formed flower. When the stamens, emerging between the glumelles, appear without, or, to use the common expression, the wheat is in flower, everything is really done. So, when we try to create hybrids—that is, new varieties—endowed with qualities wanting in one of the parents, we must take the anthers from the flowers before the plumes are open and the anthers have shed their pollen.

The operation exacts much care. When the flower is half opened, we cut off the anthers it contains and drop in the pollen of the variety which we have chosen to give the one we operated upon the qualities which it lacks. One of the most widely distributed varieties around Paris, the Dattel, was created in this way by M. H. de Vilmerin by fecundating the pistils of the English Chiddam wheat, which had fine qualities but a short straw, with the pollen of the Prince Albert wheat. The operation was perfectly successful; the straw of the Dattel is thicker and longer by at least five inches than that of the Chiddam, from which it is derived. The variety is quite fixed; it reproduces itself with well-defined characteristics; and the experiment has now been of long enough duration to make it certain that the seed sown is not

derived from plants reverting to the parental characteristics, as sometimes happens in imperfectly fixed hybrids.

When flowering takes place in good weather, fecundation goes on regularly, and the chances increase of obtaining a good crop. These chances, on the contrary, diminish when the earing occurs in a rainy time. Probably water gets within the involucre, and the wet pistils imperfectly retain the pollen grains, or their germination is irregular, the pollinic branch not reaching the micropyle, and the ovules not being fecundated; and the ears bear many sterile flowers in which the corn is not formed.

The production of the corn, of the seed which assures the perpetuity of the species, is the ultimate end of the herbaceous plant; it is essential that the reserve stores necessary for its development be accumulated around the embryo inclosed in this seed, and that it find everything near by: the starch which it will liquefy and then transform into cellulose; the gluten, the nitrogenized matter, with which it will form the protoplasm of its cells. These reserves must be abundant, so that a part of them may be burned, producing by their slow combustion the heat which favors these transformations. The whole life of the herbaceous plant tends toward this end of accumulating in the seeds the principles elaborated during its short existence; and it is precisely this accumulation in the seed of the gluten and the starch, both excellent food-stuffs, for which men have cultivated wheat from the most remote antiquity; or, if they live in different climates from ours, sow other corn plants—rice in the extreme East, maize in America—in order to find in their seeds the association of nitrogenized matter and starch which gives the grain so pronounced an alimentary value that it forms an essential part of the food of a large proportion of the inhabitants of the globe.

It is easy to follow the migration of the nitrogenized matter, phosphorus, and potash from the lower to the upper leaves, and from these to the end of the stem and the seed. The transportation of these principles has been studied for more than thirty years by a distinguished agronomist, Isidore Pierre, professor in the Faculty of Sciences at Caen. We are less well informed concerning the formation of starch. It can not be seen accumulating in the leaves of wheat as in those of a large number of other species, nor are reserves of saccharine matters found in these leaves. The formation of starch is very late, as it does not take place till during the last stage of vegetation. It thus happens that the quantities of starch contained in the grain vary greatly from one year to another.

The phenomenon of transportation and migration of nitroge-

nous substances from the leaves and the stem to the grain and the later production of starch takes place only when the plant conserves a considerable quantity of water. If the radiations of a burning sun strike upon a field of wheat the roots of which find nothing to drink in a dry soil, the plant dries up, everything stops, and the last phase of the life of the wheat is abruptly terminated; the grains remain empty, and the crop fails.

Persistent rain is no less to be feared. The wheat continues to grow indefinitely, and the migration of the principles is not brought about. I witnessed a very curious example of this in England twenty years ago. I was visiting a farm near London, where cultivation was assisted by irrigation with sewer water. The farm was slightly undulating, and the sewer water was carried over the depressions in troughs sustained a few yards above by wooden supports. One of these troughs, being in bad condition, let the liquid fall constantly in a fine rain upon several square yards of a field of wheat. It was July, and, while all the rest of the field was yellow and ready for the harvest, the stools thus watered were still green and continuing to grow, exceeding all their neighbors in height, and giving no signs of maturity.

A mild temperature and a slightly clouded sky are the favorable conditions for a good ripening. When the land has been well dug, the seeding regular, and the manure judiciously distributed, all the individual plants in the field will have expanded together, all will have passed simultaneously through all the phases of their development, and in the warm hours of the day, when all is motionless, the surface of the field, the English say, will appear as horizontal as a table.

There are no great inconveniences in harvesting a little early. The ripening, if not yet complete, will proceed very well when the sheaves are stood up against one another into those "shocks" which are much in use where severe rains are common. On the other hand, there is much advantage in not leaving the wheat standing after it has ripened. Every plant that has matured its seed tends to shed it, and sometimes the seed has powerful organs of dissemination. This is not the case with wheat; but, although it does not fly off to a distance, it escapes from overripe heads, falls, and is lost. Further, all the organs of plants respire by the aid of the oxygen of the air consuming some of their principles. In the seed the combustion chiefly affects the starch, and a crop which remains standing long diminishes in weight both by the loss of the seeds that fall and by the slow combustion which continues as long as desiccation is not produced. As soon as a field of wheat is ripe it should, therefore, be harvested, and here is where the reapers, that have been brought to such great perfec-

tion in America and England, are found to be very useful in making the farmer independent of the scarcity or the exactions of laborers.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

EVOLUTION OF INSECT INSTINCT.

By M. CH. PERTON.

I WAS a witness in 1887 of a combat between a halictus bee and its sphœcode parasite, a "cuckoo bee," which took place in the open air, outside of the nest. The nests of the *Halictus malachurus* (Kirby), which are found excavated in the compact soil of garden walks, are narrower at the entrance than below, and here the sentinel bee closes access with its head.

The sphœcode, *Sphœcodus hispanicus* (Wesmäel), twice as large as its victims, had to enlarge this entrance to effect its passage. I saw it cut up the sentinel, whose quarters came out with the digging. Very near, a halictus was assisting a dying sister whose pollen-loaded feet were still moving. She had without doubt been killed by the sphœcode. Another harvester still survived, and attacked the parasite, biting its legs and wings. The bandit, obliged to stop its task frequently, established itself near the nest and tried to seize the enemy with its sharp mandibles. The halictus at last threw itself upon him, and the two were locked in combat. In an instant the halictus was no more.

The sphœcode labored for nearly four hours to open a passage, and would perhaps have succeeded if I had not judged it prudent to capture it. It had worked till dark without having advanced more than an eighth of an inch.

Besides the deductions which other authors have drawn from the observation of insects under similar conditions to these, I found a no less important feature toward the study of instinct in the apparent development at the same time with sociability of a courage which impels the individual to devotion of itself to the common cause. The persistent struggle which my halictus maintained is, I believe, unexampled in the annals of other *Hymenoptera* than ants, wasps, honeybees, and bumblebees. It was not a rush of a moment upon the thief, or a struggle in a narrow corridor where escape was impossible after the fight had begun; but it was a foot-to-foot battle that lasted nearly a quarter of an hour, in the open field, where the halictus could run away at any moment. The assault was made vigorously, of determined purpose, the contestants fighting in close embrace, and ended in the death of one of them.

We remark that this devotion to the public weal is like society in its beginning. It is less developed here than among the wasps and the honeybees. Near the one who died so bravely on the field of honor, I saw a new halictus alight in front of the enemy at the first attack to go take care of the dying. Honeybees do not hesitate when their city is to be defended, and bumblebees, Hoffer says, often precipitate themselves upon the man who is destroying their nest; but their civilization, if I may use the word, is much more advanced than that of the halictus. Courage and abnegation are therefore not only the appanage of mankind or of rich societies of honeybees and ants; they belong to every association—to all those, whether beasts or people, who bind their hearts together in the struggle for existence.

The tenacity of the sphœcodes on the field of battle is not less surprising; it is, so far as I know, the only example of a parasite issuing from the peaceful progeny of the apiaries that gives battle for the acquisition of spoil.

Have we here a species of parasite in course of formation? I do not know. There is a great distance between the sphœcode and the halictus. The variation of the genus or species sphœcodes is very great, it is true; but that of the bumblebees is of the same order, and there are fossil bumble bees. The hazardous life of the parasite should teach us reserve concerning the cause of its variations.

I believe we may observe a nascent parasitism in another family of *Hymenoptera*. I mean among those insects which honestly gain life for their young most of the time, but which also do not disdain to rob a neighbor, to play the parasite, and that not fortuitously, but almost every time an occasion presents itself. I have found such insects in the spider-killing family of the *Pompilidæ*.

The pompiledes are those little black wasps, with a somewhat party-colored abdomen, which may be seen lingering on sunny talus or walls, with their antennæ and wings in febrile vibration. Those that I have observed in France and Algeria chase spiders. They pursue them, keeping in touch with the ground like a dog following game. The manner of attack varies with the species of the hunters. Nearly all those that I have seen light directly upon the enemy, which rolls over, and stab it. The spider is generally put in a safe place on top of a tuft or a stone, while the pompilus digs a hole in which it deposits the anæsthetized head, after gluing its egg upon the abdomen. The pompilides are not all diggers—some choose or prepare the most singular places for their progeny; but the general rule is as I have described it.

My observations have been made chiefly upon the *Pompilus viaticus* (Latreille) and on the *Pompilus rufipes* (Vanderlinden).

If we throw a spider that has been stung by a fellow-wasp at one of these, it will nearly always be taken without hesitation, and will often be stung again. The depositing and the laying of the egg are done as if by habit; and I may add that the hunter is not dainty as to the freshness of his game. I have seen spiders of eight days' standing accepted, and have repeated the experiment so often that I can not suppose that the fact is accidental. It is not a case of one opening a cell to deposit an egg because its own has been stolen, or of digging into the partitions at the end of its labors; but what I relate happens almost regularly whenever occasion offers. It may be said that the insect is obliged to deposit its egg. Perhaps, but the necessity for ovipositing is singularly elastic with my pompili, and is associated with the faculty they have of stealing the game of their neighbor.

A *Pompilus viaticus* has just drawn its spider into the cell. It has deposited its egg and stopped up its hole. I offer it a new spider, killed; it is not the time for ovipositing, but the victim is accepted and placed carefully by the side of the nest, the closing of which is arrested. A new cell is dug out, the booty is drawn into it, and receives an egg in its turn.

I have often repeated this experiment with *Pompilus viaticus* and *pectinipes*. I broke open the half-closed nest, and unfastened the egg, and I have several times seen the spider taken up, carried a little farther on, and the ovipositing begun again.

So far I have told of experiments; now I come to pure observation. Let us go at the beginning of September into a warm gravelly quarry. We see many hymenoptera there, but the pompilides dominate. They have chosen the most agreeable quarter, the most sunny one in the city. Those which I observed were the *Pompilus rufipes*. They are a colony of crafty fellows, constantly in motion, ferreting everywhere, sometimes on the quest for a neighbor's spider, going into the holes which they find to their taste to drive the proprietors from them. When they have succeeded in stealing, they bury their spoil, if some other thief does not interfere, and deposit an egg upon it. These thefts are often the occasion of lively combats. I chanced to see two of the largest of the band disputing over a spider. Hunters and victim rolled like a ball along the gravel for four or five yards. The contestants, which had not let go, tugged at their prey like dogs wrangling over a bone. After a few minutes the beaten one—generally the less corpulent—gave up the struggle. The species, however, is not parasitic. The spider is in the beginning the legitimate prey of one of the two, and I have, besides, seen them hunting and ovipositing honestly in the same quarry.

Not only in the capture of the prey, but in the choice of the

nest, too, a very great adaptation of instinct to conditions exists among the pompilides. They turn everything to profit.

Taschenberg* says that the *Pogonius* nest in the sand. I have found *Pogonius bifasciatus* nesting in a hedge at Châtellerault in abandoned snail shells. Some shells contained as many as three cocoons. This year, at Algiers, I found bulimus containing cocoons which have not hatched at this writing, but which strongly resemble the cocoons of my pogonius. If Taschenberg has not made a mistake, the insect is a digger that does not always dig. I have long observed a little pompilus at Châtellerault which I have not been able to identify. I have seen it nesting almost everywhere—in snail shells, in the rotten mortar of old walls, and in worm-eaten wood, digging when it had no other way. One day it even had the audacity, while we were at lunch, to bring its spider to my sister's hair.

We are therefore, it seems to me, contemplating an eminently variable instinct, which, joined to the tendencies to parasitism of which I have just spoken, suggests that a parasitical branch may be even now detaching itself from the pompilus type.

The pompilides, or some among them, have possibly been showing these tendencies for many centuries. The walks of the garden near Algiers are crowded in October with small spiders which pass the day hidden in holes closed by a stone or a clod. I have observed that a little *Salius* knew very well how to open this retreat, go in, and kill the inmate. Prof. Pérez, in his contributions to the apian fauna of France, has studied the parasites of bees in a masterly manner, but he has almost omitted the study of instinct in the formation of parasitism. I have no more than suggested the question, but I believe we might easily give an acceptable answer to it with the help of the pompilides. If we succeed in this, we shall perhaps have answered the challenge sent out in his Souvenirs by the entomologist of Sérignan: "Let them show me a species in the course of transformation."—*Translated for the Popular Science Monthly from the Revue Scientifique.*

A CURIOUS experiment is recorded in *La Nature* by M. F. Crestin, in which, by the application of a magnet, he extracted a needle from a woman's hand, in which it had been imbedded two months. The hand was placed upon one of the poles of an electro-magnet, and a current giving an attractive force of three grammes was applied for about two hours at a time. After nine sittings, or about twenty hours of magnetic action, the needle, with the point broken off, came out and adhered to the magnet, the whole operation having been performed without pain or loss of blood.

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* *Die Hymenoptera Deutschland*, etc.

"DEAF AND DUMB."

By MABEL ELLERY ADAMS.

THE average man has no idea of the real meaning of the common adjective phrase "deaf and dumb." He occasionally sees a group in some public place conversing by means of signs or the manual alphabet, and he says to himself, "Deaf and dumb." Less often he comes in contact with an orally taught deaf person, and either talks with him or hears others talk with him, and goes away and says: "I met a deaf and dumb man to-day and heard him talk; it's wonderful, wonderful!" quite unconscious meantime that his way of expressing what he saw is also wonderful.

Sometimes this same average man hears that a friend's child has been born deaf, and if he is a little conservative he says: "Oh, well, the child can be educated at the Deaf and Dumb Asylum; they teach them everything there. Many deaf and dumb people are able to make a good living nowadays." If, however, our average man is fully up to the times, he says: "Oh, the child can be taught to talk just like other folks; they have got a way of teaching the deaf and dumb children to speak and to understand other people by looking at the motions of the lips; so they get along just about as well as though they could hear."

All this is very crude, no doubt, but it is safe to say that nine out of every ten people in ordinary life, whom circumstances have never brought in contact with the deaf, have very much the same ideas. To be deaf is to be unable to hear, and to be dumb is to be unable to talk. The lack of hearing is remedied by teaching the child to use his eyes and understand either signs or the motions of the lips, and the lack of speech is remedied by teaching the child to use his vocal organs or his hands to make others understand, and behold! the task is accomplished, and he is "just like other folks." Not one thought is given to language, to the wonderful medium of exchange by means of which the business of life is carried on, that is supposed to come by Nature, or instinct, or miracle, but never by teaching. A cultured lady, a literary woman, said to me once, after seeing some deaf children and hearing them go through certain vocal exercises which included every elementary sound in the English language: "Now, if these children can make all these sounds correctly, why don't they go right on and *talk?* What hinders them?" She was a bright woman, and when a very short explanation had been given her, the reason flashed upon her, and she said: "Why, what a fool I am! I see, they've got something to say, and the mechanical ability to say it, but no language to say it in," and in that one sentence she expressed the reason for being of all the institutions and schools for the deaf in

the country. "No language to say it in," that expresses the condition of a deaf child's mind before he is taught very well, but perhaps "and no language to *think* it in" should be added. Let the reader try for himself and see how much consecutive thought he can accomplish without words; and if, with his mind trained by years of intelligent thinking, he can do little until the words come, let him imagine, if he can, the state of a mind cut off from language.

By way of example, let us take the seemingly simple fact of similarity or likeness between two objects. Your three-year-old baby says, "I want a woolly baa-lamb like that one," or "Dose two kitties is dust alike," or "Mamma, you didn't give me the same as brother"—all expressions of the same idea of likeness. Now, an ordinary deaf child is eight or nine years old before he has acquired language enough to express either in speech or writing what the baby just learning to talk has said so easily—namely, the idea of similarity. Not but what he *knows* the things are similar; in this case it is simply the language that is wanting.

Language is a growth. A hearing child begins to absorb language from the very day of his birth. When he gets to be thirteen or fourteen months old, sometimes when he is younger, he begins to give back a word or two of the thousands of words which have been given to him over and over again every waking hour since he was born. It must be remembered that words spoken in a child's hearing are just as much given to him as words spoken directly to him. From the single words with which a baby begins he goes on to phrases and sentences, constantly learning to use more words or to use already familiar words in new ways, until at seven or eight or nine he is able to talk about common things just as intelligently as do his father and mother. In other words, he has *learned* to talk. His language has grown with his growth, nourished by the daily gifts of those about him, unconsciously given and unconsciously received, no doubt, but none the less contributing their share toward the future structure—i. e., the ordinary vocabulary of man.

Now let us see how the deaf child fares during these impressible years while his hearing brother is absorbing so much. He sees just as much as do the people around him, but it is all unexplained. If you were set down suddenly in utterly strange surroundings, you would be dazed until some explanation was made to you, but the deaf child must go without explanation for years. Life is one long pantomime to him until he goes to school, and the pantomime often means one thing to the person who uses it and another to the person who sees it. While the hearing child is acquiring the language of home, of play, of the street, of time and place and weather, of buying and selling, loving and praying, the deaf child is gaining only crude ideas of all these subjects.

Let me illustrate, if I can. Take the matter of buying and selling, for instance. A hearing child wants to go to the store and buy five cents' worth of candy. Think how much language he uses in talking about it! He says: "Mother, I want five cents to go to the store and buy some candy. Will you give me five cents? May I go to the store? Please let me go. If I am good, may I go?" When he gets to the store he says: "I will have one stick of that, and one stick of that, and a cent's worth of this," etc., and when he comes out he says: "I bought some candy. I like to trade at that store. The woman gives good measure"; and when asked, "Who sold it to you?" he says, "Oh, the woman herself." Now look back, if you please, and observe the amount of language used in connection with this one very simple transaction. See the different moods and tenses, and the different constructions introduced. If an uneducated deaf child wanted to go to the store and buy some candy, he would hold up five fingers to his mother, put his hand to his mouth to indicate candy, and then make some sign for store, perhaps a gesture to represent the act of paying; and after he had been to the store and bought his candy, he would go through just the same pantomime to indicate the finished action as he used to indicate his unaccomplished wish, for he can not distinguish between time past and time to come by natural pantomime.

If this illustration seems tedious in its details, it must be pardoned, for its object is to make the average man see the great gulf which exists between the deaf child who knows how to buy some candy and the hearing child who knows how to buy it and talk about it, to express his desire for it, and to relate the facts concerning the purchase. There is but one bridge for this gulf, the bridge of language, and all the teachers of the deaf in this or any other country are at work building this bridge. They differ in their tools and in their methods of building, but their aim is always the same. Language, be it spoken or written, is what the deaf child must have if he is to understand the world about him as his hearing brother understands it, and all the discussion of the educators of the deaf to-day is as to how it can best be given to him.

The builders who have this task to accomplish work in two ways. Some—and they are among the oldest and the wisest of the master builders—lay their foundation and make the base of their structure of a material different from the bridge itself, while others use but one material from deepest-driven pile to topmost guard-rail. Each party of workers claims that its structure is the stronger and furnishes an easier highway whereby the deaf may pass from the isolation of their wordless state to companionship with the hearing, speaking world.

Is the figure too complicated? A large number of the teachers of the deaf either teach, or allow the children to acquire from their schoolmates, a language of conventional signs. This language has a grammar and construction of its own, and an order differing from that of the English language; it is very comprehensive and flexible, and by means of it deaf children soon begin to enlarge their mental horizon. They find it tolerably easy to acquire, too, because many of the simpler signs are almost identical with the natural signs which they have learned or invented at home. By means of this sign language these teachers of the deaf impart ideas to their pupils, and these ideas they put into English, written English usually, and then spelled English (English spelled by the fingers), teaching the pupils to reproduce the English. To the children who show an aptitude for it they teach spoken English as well, and a comprehension of the spoken English of others, known as lip-reading. The deaf so taught usually converse among themselves by means of signs, and also use the sign language with such hearing persons as understand it. With such as do not understand signs they use the manual alphabet or writing, unless they are able to use speech intelligibly. The less intelligent think in signs; the more intelligent think in either written or spelled English, and, where they use speech, mentally translate. The method thus roughly outlined is known as the combined method. Nearly all the large institutions in the country use the combined method. The amount of speech, however, which is "combined" with the signs and written and spelled English varies greatly in the different States.

Two or three institutions, several day schools, some private schools, and many private teachers use another method, which differs radically from the one imperfectly described above. This method is the oral, or pure oral. Every child who enters an oral school is taught by speech, supplemented by writing. The sounds which make up the English language are taught to him—sometimes separately, sometimes in short words. He is made conscious of his own voice by feeling the vibration which it produces at the throat, under the chin, or at the point of the chin. His attention is called to the mouths of those about him moving in the motions of articulate speech on the first day of his school life, and, from that day until the last, he sees his teachers use only, as a method of communication with each other or the pupils, the English language, in either its spoken or written form. An atmosphere of English is created about him, and, as his vocabulary grows, he shapes his thoughts by means of words. His range of thought as he grows older is widened by means of the ordinary studies of the ordinary schools—stories, geography, history, physiology, biography, etc. What he does not understand is explained to him by

means of what he does understand; simple language is used to make complex language more clear; but whatever is done is done by means of language, either spoken or written, so that what he writes or speaks is his own thought unhindered by mental translation.

There are cases which both these methods fail to teach, very moderate successes under both methods, and, besides, some very brilliant examples of highly educated, cultured, deaf ladies and gentlemen who have so far mastered the difficulties which beset them that they are able to take their places in life almost as though one sense were not lacking. The representatives of this last class who are personally known to me were all but one educated by the oral method. This one exception is a very warm advocate of the oral method, in spite of the fact that he was educated under the combined system.

The large number of average cases—the deaf people who are neither brilliant scholars nor apparent failures—are generally advocates of the system under which they were educated. The combined-method pupil claims that he enjoys life better because he has his signs by means of which he can take pleasure in the company of his deaf friends, and the oral-method pupil claims that with his speech and lip-reading he can accommodate himself to his environment in the speaking world; and that, if his speech is not understood, his written English is just as good as his brother's of the combined method.

And so it goes. Each thinks his own way the best.

A WRITER in Blackwood's Magazine, on the philosophy of blunders committed by persons under examination, assumes that the questions asked by the examiner are intended to awaken a recollection or to develop a kind of process of reasoning in the candidate. If the reasoning fails at any point or from any cause, a blunder appears in the answer. Some of the blunders cited by the writer, particularly in the scientific examinations, betray great confusion of mind, and are hardly accountable except on the supposition of inexact teaching or too hasty cramming. What did the pupil mean who answered that during summer "the weather is getting gradually warmer, caused by the rotation of the sun"; or that one who said that "the Tropic of Cancer is the meridian which passes round the earth midway between the equator and the Tropic of Capricorn"? Various pupils answered questions about the tides by saying that they were "caused by evaporation," "by prevailing winds," "by different oceans meeting each other," "by the undercurrents meeting," "by the waves of the Atlantic pushing the surface waters westward," or other phrases, all betraying a confused recollection of some of the words they have read in the text-books, without the most remote conception of their meaning or their relation to the subject. Such obvious illustrations of the faults of defective teaching bear their own comments.

SKETCH OF WILLIAM C. REDFIELD.

THE life of WILLIAM C. REDFIELD, said Prof. Denison Olmsted, in a memorial address delivered at the time of his death, "affords an interesting and instructive theme for contemplation in a threefold point of view—as affording a marked example of the successful pursuit of knowledge under difficulties, as happily illustrating the union in the same individual of the man of science with the man of business, and as exhibiting a philosopher whose researches have extended the boundaries of knowledge and greatly augmented the sum of human happiness."

Mr. Redfield was born near Middletown, Conn., March 26, 1789, and died in New York city, February 12, 1857. His father followed the seas as a profession from early youth to the time of his death. His early training was therefore derived from his mother. He was given such instruction as the common schools afforded. Having removed to Upper Middletown, now Cromwell, he was apprenticed to a saddler. He gave all the time he could afford, which was only a part of his evenings, to study, preferably of science, having most of the time only the light of the wood fire to read by. But before he was twenty-one years old "he had acquired no ordinary amount and variety of useful knowledge." With other young men of the village he formed a debating society, which was called the "Friendly Association," and which collected a library. Dr. William Tully having settled in the village, young Redfield applied to him for the loan of some books, and engaged his interest. No particular book was asked for, and the cases were opened for him to choose. He selected Sir Humphry Davy's Elements of Chemistry.

His mother removed to Ohio during his apprenticeship, and in 1810 he set out to visit her, going, with two companions, on foot. He regularly took notes of what he observed and experienced in a tramp through the country of western New York and northern Ohio, which was then very primitive; returning in the spring, again on foot, he took a more southerly route. His notes were afterward turned to good account in making the sketches of the railroads he projected. After this journey he engaged in business in Middletown, following his trade and keeping a small country store. He assumed the initial C. when he had come of age. In 1827 he removed to New York city.

A violent storm had swept the Eastern States, September 3, 1821, which became memorable as the "Great September Gale." Shortly after it occurred Mr. Redfield traveled through a part of the region over which it had passed, and was surprised to observe that in one part of his route the trees lay with their heads point-

ing toward the northwest, and in another part in the opposite direction or toward the southeast, and to learn that while the wind had been blowing violently from the southeast at Middletown, it had been blowing just as violently less than seventy miles away from the northwest. These facts and his reflections upon them led him to certain conclusions which business engagements prevented his developing at the time, but which he published, fortified by the citation of numerous observations and with illustrations drawn from other storms, in an article in the American Journal of Science for January, 1832, on The Prevailing Storms of the Atlantic Coast. His conclusions were, in short, that the storm was a great advancing whirlwind, and that tornadoes generally revolve on an axis of rotation and move with the main currents, exhibiting, consequently, retrograde motion on one side of the axis and progressive motion on the other side. In a subsequent article in the same journal he discussed the hurricane of August, 1831, as illustrating the position that storms and hurricanes are gyratory in action, and move with the general current of the region in which they occur. These views are now in the main accepted facts in meteorology.

Prof. Olmsted gives, in his memorial address, a very interesting account of the way the first article came to be published. In it we have a picture of the man Redfield. "I chanced at this period," he says, "to meet him for the first time on board a steamboat on the way from New York to New Haven. A stranger accosted me, and modestly asked leave to make a few inquiries respecting some observations I had recently published in the American Journal of Science on the subject of hailstorms. I was soon made sensible that the humble inquirer was himself a proficient in meteorology. In the course of the conversation he incidentally brought out his theory of the laws of our Atlantic gales, at the same time stating the facts on which his conclusions were founded. This doctrine was quite new to me, but it impressed me so favorably that I urged him to communicate it to the world through the medium of the American Journal of Science. He manifested much diffidence at appearing as an author before the scientific world, professing to be only a practical man, little versed in scientific discussions, and unaccustomed to write for the press. At length, however, he said he would commit his thoughts to paper and send them to me on condition that I would revise the manuscript and superintend the press. Accordingly, I received the first of a long series of articles on the law of storms and hastened to procure its insertion in the Journal of Science. Some few of the statements made in the earliest development of his theory he afterward found reason for modifying, but the great features of that theory appear there in bold relief."

Other articles confirming the position first taken followed, among them one on the hurricanes and storms of the West Indies and the coast of the United States, and the uniformity of their general character, in which the storms of the China Sea were shown to be similar to those of the West Indies, and the gyrations in the southern hemisphere to be opposite to those in the northern; one presenting a general view of the atmosphere and its currents, and a classification of storm winds, predicating the identity of whirlwinds and water spouts, and discussing the great aërial currents; and articles on tidal movements, climate as connected with atmospheric and oceanic currents, the Gulf Stream, and polar currents.

The main features of Mr. Redfield's theory of storms, as stated by Prof. Olmsted, are:

"That all violent gales or hurricanes are great whirlwinds, in which the wind blows in circuits around an axis either vertical or inclined; that the winds do not move in horizontal circles, but rather in spirals toward the axis—a descending spiral movement externally and ascending internally.

"That the direction of revolution is always uniform, being from right to left or against the sun on the north side of the equator, and from left to right or with the sun on the south side.

"That the velocity of rotation increases from the margin toward the center of the storm.

"That the whole body of air subjected to this spiral rotation is, at the same time, moving forward in a path at a variable rate, but always with a velocity much less than the velocity of rotation, being at the minimum, hitherto observed, as low as four miles, and at the maximum forty-three miles, but more commonly about thirty miles an hour, while the motion of rotation may be not less than from one hundred to three hundred miles per hour.

"That in storms of a particular region, as the gales of the Atlantic or the typhoons of the China Sea, great uniformity exists in respect to the path pursued; those of the Atlantic, for example, usually issuing from the equatorial regions eastward of the West India Islands, pursuing at first a course toward the northwest as far as the latitude of 30°, and then gradually wheeling to the northeast and following a path nearly parallel to the American coast, to the east of Newfoundland, until they are lost in mid-ocean, the entire path when delineated resembling a parabolic curve whose apex is near the latitude of 30°.

"That their dimensions are sometimes very great, being not less than one thousand miles in diameter, while their path across the ocean can sometimes be traced for three thousand miles.

"That the barometer, at any given place, falls with increasing

rapidity as the center of the whirlwind approaches, but rises at a corresponding rate after the center has passed by; and, finally,

"That the phenomena are more uniform in large than in small storms, and more uniform on the ocean than on the land."

"These laws Mr. Redfield claimed as so many facts independent of all hypothesis—as facts deduced from the most rigorous induction, which will ever hold true, whatever views may be entertained respecting the origin and cause of storms."

Mr. Redfield's conclusions were reached after the collection and collation of as many records as possible of observations of the storms investigated, particularly of vessels which had been caught in them, the independent accounts of one storm having been one hundred and sixty-four in number; the charting of them; and the tabulation of the various data of them.

The next step was the suggestion of the methods by which vessels might avoid storms or escape them by sailing out of them.

Views like those of Mr. Redfield were reached about the same time by Dove, but Redfield knew nothing of his work. Colonel Reid, of the Royal English Engineers, at Barbadoes, who was also studying the subject, was struck with Redfield's articles, and entered into correspondence with him, which was continued to their mutual advantage. Mr. Redfield further speculated on the causes of storms—a subject which he was not able to solve, and which is still in large part a mystery.

In 1820 Mr. Redfield became interested in steamboat navigation, and ultimately associated with enterprises for carrying it on. The public had become alarmed about boiler explosions, to the detriment of the passenger traffic. To overcome their objections, Mr. Redfield devised a system of "safety barges," to be towed upon the Hudson by steamboats placed at such a distance that the passengers should be out of reach of the danger of explosions. These barges, which were in use from 1825 to 1829, attained a speed of between eight and nine miles an hour, and were in favor while the terror of explosions continued. But there came a lull in the explosions, the size and speed of the steamboats were increased, and conveyance by barges was discontinued, "to the regret," Mr. Redfield observed in a paper on the subject published in the American Journal of Science, "of those who love quiet enjoyment and whose nerves have not been inured to composure by frequent proximity with the moving power." In the same article Mr. Redfield undertook to show that the exposure to fatal accidents on board of steamboats was much less than attended the use of the ordinary means of conveyance by either land or water, and even than that from lightning. The towing system, originated by Mr. Redfield, though it lost favor as a means of conveying passengers, was extensively applied to the conveyance

of freight, and is still an increasingly important method of transportation in that department. Mr. Redfield, associated professionally with the "Steam Navigation Company," continued to apply himself to the improvement of the art, devising better forms of apparatus, seeking for the best methods of regulating steam navigation, which he did not find in legal enactments, inquiring into the causes of boiler explosions and suggesting means of safety, and calling attention to the value of steam in national defense.

While railroads were still an experiment in this country—the Albany and Schenectady Railroad having been completed only in 1826—Mr. Redfield, in 1829, published a pamphlet outlining a project for one system of railroads connecting the Atlantic with the Mississippi, in which he made useful the knowledge of the country which he had gained in his walk to Ohio. The route he indicated was substantially, as far as to the lakes, the one afterward followed by the New York and Erie Railroad. The Erie Canal was then popular, and seemed to respond to the public demand for quick transportation; and so the author set forth, under nineteen distinct heads, the superiority of railroads to canals—a principle which was only a theory then, and to which men had to be won by argument. "He even anticipated," Prof. Olmsted observes, "that after the construction of the proposed great trunk railway connecting the Hudson and Mississippi, many lateral railways and canals would be built, which would bind in one vast network the whole great West to the Atlantic States. 'This great plateau, says he, will indeed one day be intersected by thousands of miles of railroad communications; and so rapid will be the increase of its population and resources that many persons now living will probably see most or all of it accomplished.'"

In 1832 Mr. Redfield was associated in the examination of the country through which the Harlem Railroad runs, with a view to establishing a road to Albany. He assisted in procuring a charter for the road, and published a pamphlet concerning it. He further assisted in the survey of a railroad route from New Haven to Hartford. He also showed his faith in street railroads, having as early as 1829 petitioned the Common Council of the City of New York for permission to lay an experimental track in Canal Street. At a later period he was a member of the Board of Directors under whom the Hudson River Railroad was completed.

While Mr. Redfield's fame rests mainly on his studies in meteorology, his contributions to geology were likewise important. Even as early as his journey to Ohio in 1810 he made geological observations. He was always much interested in the

geological papers in the American Association, and took part in the discussions of them. The phenomena of the drift period and the signs of glacial action attracted his attention; but, living in the heart of the new red sandstone region of Connecticut, his closest studies were directed to that formation, and the fruits of them appear in several papers in the American Journal of Science. In these papers he described the allied sandstones of New Jersey as well as those of Connecticut, with their fossils, ripple marks, and evidences of the fall of raindrops. His son, John H. Redfield, having, in a description of the fossil fishes of the Portland quarry near Middletown, showed that their structural affinities pointed to a higher position for the sandstone than had previously been assigned to it, he continued the study and published descriptions of several new species of ichthyolites. The last paper he read before the American Association was on the Geological Age of the Sandstones of Connecticut and New Jersey, and the Contemporaneous Deposits of Virginia and North Carolina. He proposed for them the name of the Newark group, and showed that the ichthyolites contained in them pointed unerringly to the Jurassic group. The collection of fossil fishes which he formed in the course of this study, with special reference to a monograph upon them, was regarded by Prof. Olmsted as having been probably unequaled in this country.

Mr. Redfield was an active member of the American Association of Naturalists and Geologists, and was the originator of its enlargement into the American Association for the Advancement of Science—"the first," Prof. Olmsted says, "to suggest the idea of the American Association on its present plan."

Prof. Olmsted gives a list of sixty-two scientific papers in meteorology, physics of the globe, and geology, on steamboats, etc., published by Mr. Redfield. Forty-five of these are to be found in the first fifty volumes of the American Journal of Science, and twenty-eight of them are registered in the catalogue of the Astor Library.

SEEKING to determine what attracted insects to flowers—whether the color, shape, or odor—M. Félix Plateau experimented with single dahlias trained against the wall. He disguised the flowers in a variety of ways, covering them all over with variously colored papers, leaving the yellowish centers of tubular flowers, giving different shapes to the papers, covering with green leaves, and so going through the changes. It seemed all the same to the insects: they found the flowers and enjoyed themselves with them in their usual way. M. Plateau concludes that the attractions of the flowers are not in their form or color, but that the insects are drawn to them by some other sense than that of sight, probably by the smell.

Editor's Table.

"THE NEW WOMAN" AND THE PROBLEMS OF THE DAY.

AS there is a new everything in these days, we suppose it was inevitable that there should be a "new woman"; though why a new woman more than a new man it might not be easy to explain. For our part we believe but faintly in "new" woman; we believe in woman. We believe in progress; we believe that new times call for new measures; we believe that these are new times, and that it behooves both men and women to prepare themselves to meet the demands which the age is making on them.

What is really new in the world is knowledge. We see the practical outcome of the new knowledge in the transformation that has taken place in the arrangements under which the life of society to-day is carried on. With the new knowledge there has come a vast enlargement of human power in all directions and a vast development of human individuality. Custom, though still powerful, is no longer such a ruler of men's lives as it used to be. Men and women everywhere have been roused, we might almost say stung, into a sense of individual existence; and, looking round on their changing environment, they are asking a thousand questions to which as yet no very certain answers can be vouchsafed. Woman is awake because man is awake; the keenness of the times has roused them both; and from both we seem to hear the inquiry made by the jailer at Philippi, when startled from slumber by the trembling of the earth and the flashing of a strange light: "What must I do to be saved?" The difference between the so-called "new woman" and woman without that qualification is that the latter would wish to be saved with man and the former apparently without him. The new variety emphasizes the fact that she is a woman, and in that capacity is going to do wonderful things; whereas woman without the "new" is content to know herself a woman and to feel that with her it rests to accomplish her equal part in all the best work of the future.

The great change, as we have said, is that there is more knowledge in the world and that the rule of custom is to a large extent broken. Things that once had all the authority that convention and routine could give them are now open to every one's criticism. Morality no longer rests in absolute security upon dogma. The time has come which Voltaire predicted would be the end of all things, when *the people* have taken to reasoning. Fortunately, there is no need to agree with Voltaire; but it is necessary to recognize that something is needed to give wise direction to the emancipated thought and action of our time. The dogmatic morality of the past was in the main sound; and the problem of to-day is to secure a sufficient sanction for whatever rules of conduct are necessary to the well-being of individuals and of society. That much in the way of wise counsel and true inspiration may be expected from the increased reflectiveness of women we most gladly recognize; but we do not feel disposed to call a woman who thus responds to the needs of the time a "new" woman, seeing that for generations past, and particularly in times of emergency, women

have more or less fulfilled the same rôle.

The two principal questions which to-day confront society relate to the future relations of men and women and the education of the rising generation. The allegation is freely made in many quarters that marriage is a failure; and no doubt frequently it is. None the less, however, is it the case that no scheme that has ever been proposed as a substitute for marriage merits a moment's consideration. It is easy to provide theoretically for the gratification of passion and impulse, but not so easy by any means to show how by any union less solemn and abiding than marriage the higher natures of men and women can be duly developed and their lower propensities kept in check. We do not look to any new woman for light on this question; but we do look to the best women of to-day, those who to purity and soundness of instinct add a trained capacity for independent and intelligent judgment, to join with the best men in indicating the higher path which the generations of the future may tread. We may be sure of this, that the path is one not of less but of greater self-control, and that redemption from the miseries which attach, in too many cases, to marriage as it is will be found in an elevation and purification of the whole idea of marriage. Not that the idea has not been held in its highest purity by many in different ages; not that the world has ever lacked examples of ideal marriage, but that there has never been a sufficiently wide recognition of its true nature and possibilities. There is a gospel on the subject which has to be preached and, so far as individual action can do it, enforced—the gospel that the true happiness of a man and woman united in marriage bonds consists in learning, as years go on, to love and respect one another more and more, and in aiding and stimulating one another more and more to right and noble action, each gaining strength through the other, each finding in the other the means of achieving a true individual completeness. The true gospel is that there is *more* in marriage than for the most part poets have sung or romancers dreamed, and that the failures of which we hear so much have been, in the main, failures to grasp the true conception of it and to make a right preparation for the duties which it involves.

Does not all this mean, it may be asked, that many are unfit through defect of character, and others through ignorance and general inferiority of thought and sentiment, to make the best of marriage? It certainly does, and here the no less important problem of education comes in. In these days we look too much to the state to solve our problems for us. There are some problems which the state can not solve, and one, we do not hesitate to say, is the problem of a true education. The state can levy taxes and employ agents and make regulations; but it can not speak with the voice of father or mother; it can not speak confidentially to the young of their deepest interests. It can enjoin rules of conduct, but it can not guide aspiration; it can not meet what, in a broad sense, we may speak of as spiritual needs. If the rising generation is to be adequately educated, the best men and women of the day must come together and consider how it is to be done—how the work of the state is to be supplemented by individual endeavor, so that growth in character may keep pace with growth in knowledge and intelligence. There are two main ways in which, at first sight, it seems possible this might be done, or at least more or less hopefully attempt-

ed: first, by an improvement of the home, and, secondly, by the action of a higher public opinion on the schools. We quoted, some months ago, an eminent French writer of our own day as saying that it was necessary to put more "soul" in the public schools. That is precisely what they want, as all the best teachers are fully aware. But you can not make an appropriation for "soul." It is not quoted in the catalogues of school supplies; it is not among the prescribed subjects in teachers' examinations. It is a very real if not a very tangible thing; and it is a communicable thing. There are those who have it and can impart it; in deed, those who have it can hardly fail to impart it. If there is enough of it outside the schools, it will leak in; and our hope is that the best men and the best women of the day will so join forces as to create, especially around the public schools, an atmosphere of higher sentiment that shall affect for good the working of the state machine, and greatly strengthen the hands of all who, within the schools, have set for themselves a certain standard of spiritual as distinct from merely intellectual accomplishment.

Then as to the home. Here is where we want women with new knowledge, but not—we speak with all due fear and trembling—"new" women. The "new woman" would set every one discussing rights; but the *true* woman with adequate knowledge would see what the best women have always seen, that the home requires a principle of unity and not a system of scientific frontiers or an elaborately arranged balance of power. Home life and home influence have, we fear, been suffering in our day through a variety of causes; but the home, like marriage, is an institution which only needs to have its possibilities developed in order to stand forth more than justified. Without entering into the question as to whether the wisest methods are being followed to-day in the education of women, it is beyond all doubt that women have gained a vast enlargement of their intellectual horizon, and that in many cases women are not only the peers but the superiors of men in the same station in life as themselves in knowledge and culture. Such knowledge and culture can nowhere be better employed than in the home, where the physical, mental, and moral development of children has to be watched over. The question is, How far will it be employed in this way, and how far made a means of mere personal self-assertion? The true woman will use it for the good of others, and, if possible, will make it available for the improvement of the home; while others—the new type—will use it to make themselves conspicuous in the world, and, as they vainly fancy, add glory to the female sex.

The hope of the future lies mainly in well-ordered homes—homes in which children are trained to be just, reasonable, and humane, in which they are taught to look with an intelligent eye upon the phenomena alike of Nature and of society, in which they learn lessons of industry and self-reliance, of honor, purity, and self-respect, and are guarded against the vulgar worship of wealth and worldly success. It is for the wise and noble women of our time to help to make such homes, and it is for men to see to it that they are worthy of partnership in so sacred a cause. It is no time for any silly rivalry or futile opposition between men and women, who are as necessary to one another now as at any previous age in the world's history—nay, more necessary. On the contrary, it is a time for earnest counsel and vigorous co-operation on the part

of all who have the interest of the present and future generations at heart; and the less we hear of the separate and conflicting claims of men and women the better. There is ample scope to-day for the efforts of all, and if any stand idle in the vineyard it must be from lack of will, not from lack of opportunity.

AN ALMOST TOO SUCCESSFUL JOKE.

WHEN a valued contributor and prominent man of science offered us for publication recently an article over his own signature intended to cast not undeserved ridicule upon the insatiable craving which so many have for marvels, and particularly for marvels that seem to possess the crowning merit (in their eyes) of casting uncertainty upon the methods and conclusions of physical science, we decided to publish it; and it appeared in our last number, under the title of The Sympsychograph. The result, to speak frankly, has almost caused us to doubt the wisdom of the step. Nothing, we know, was further from the intention of the writer, Prof. D. S. Jordan, than to hoax or mislead intelligent readers; and we need hardly say that no such purpose could possibly have commended itself to our approval. There is reason to believe, however, that the great weight attaching to Prof. Jordan's name threw many persons off their guard who would otherwise have scanned the article with sufficient closeness to perceive not only its lack of scientific coherence, but the mischievously sportive intent underlying it. To such, we feel like offering an apology: they read in good faith, as a serious article, what was written as a burlesque, and, doubtless in some cases, puzzled very unnecessarily over the incoherences and obscurities which naturally entered largely into its composition. Many a one doubtless said: "This does not read like an article by Prof. Jordan, yet his name is signed to it; it must be his, and there must be something in it." Well, there was nothing in it except a burlesque; and if any of our friends feel that they were unfairly entrapped into taking it seriously, we can only express our sincere regret.

It is worth while, however, for those who took it seriously to reflect for a few moments over *what it was* that they thus gave credence to. The statement was that photographs were produced in absolute darkness; that in the darkness a photographic plate became sensitive to thought; and finally, that the thought of a cat in the mind could so decompose the film on a prepared plate as to produce thereon the image of a cat. This was a feast of absurdities which our contributor doubtless supposed, and which, we must confess, we ourselves supposed would prove too rich for all but the most credulous; and if, on a review of the case, those who were taken in are led to draw the inference that a certain independent exercise of judgment is always in order, and that no name should be accepted as sufficient voucher for stark absurdity, the annoyance to which the incident has given rise will not be unmixed with benefit.

If any reader should perchance ask whether there is anything more incredible in the alleged performances of the "Astral Camera Club" than in what we have learned this year in regard to the X rays, we answer: Yes, there is, on the surface, all the difference in the world between the two cases. In the case of the X rays, Prof. Röntgen made his announcement in a carefully worded memoir addressed to a learned body, and fully discussed therein the work done by predecessors in, if not the same, an adjoining field of research.

In the second place, there was a known cause of the effect produced in a powerful electric disturbance of an attenuated gaseous medium. There was something here which might very conceivably possess an action resembling that of light upon a photographic plate, and, seeing that ordinary light rays can pass through various solids, it was not taxing belief unduly to state that the X rays could pass through solids impermeable to ordinary light. If intelligent persons will only use the full measure of their intelligence in discriminating between authenticated and unauthenticated announcements, between consistent and inconsistent statements, between alleged facts that have a history behind them, and appear in some natural order of development, and others that have as little previous history and as little in the way of development as "the shield that fell from heaven," they will be all the better for it. They will gain in intellectual power, and, as a result, will be less at the mercy of the manufacturers of the marvelous. It may be a little difficult to exercise discrimination to this degree, but who can deny that the effort to do so would be eminently beneficial? The late Mr. Bagehot once wrote an instructive article on The Emotion of Belief, in which he showed to how large an extent emotion is responsible for belief. It is so to altogether too large an extent: when people believe, they are very often indulging an emotion instead of completing an intellectual process. This emotion is continually demanding nutriment and stimulus; and we need to be on our guard if we would not be continually believing simply for the sake of the pleasure accompanying the act.

We therefore see a good moral associating itself very closely with Prof. Jordan's *jeu d'esprit*; and there is consequently reason to hope that, when the returns are all in, the balance will be on the right side.

FADING FADS.

A CORRESPONDENT of The Nation, writing from Geneva, thus reports in regard to the Third International Congress of Psychologists lately held in that city: "The fact that the papers on 'hypnotism' were less than in earlier congresses, in proportion to the entire number, and that there were a bare half dozen on thought-transference and telepathy, shows the general tendency of psychology. The hypnotic period is past even in France. . . . As to telepathy, I think there is a real decay of interest in the subject, much as this is to be deplored." We must confess we do not feel like deploring the decay of interest to which the correspondent alludes. There would not be such a decay if facts were forthcoming of a nature and in sufficient number to sustain the interest. Telepathy is one of those things that appeal most strongly to popular credulity. The subject, or rather the alleged facts, might be studied without injury by a man of scientific training; but, handed over to the multitude, it is well adapted to become the fruitful source of every kind of intellectual mischief. There are hundreds of minds to-day that are perilously near the border land of insanity, and still more that are in a most unwholesome fever of unrest, simply on account of the obliteration, so far as they are concerned, of the boundaries of the possible and impossible. They do not know what to believe in or what to expect in the way of incursions from an invisible and intangible world, or what law of Nature they can safely regard as irreversible. Can any good come of this? We should certainly say

No; and we are sorry that some people of more or less scientific competence, who, as we think, might be better employed, are devoting their efforts toward promoting this general condition of mental unsettlement. It is a comfort to learn that the assembled psychologists at Geneva were not disposed to give much countenance to the telepathic Will-o'-the-wisp.

THE ABUSE OF FREE LIBRARIES.

At its recent annual meeting in Cleveland, the American Library Association heard some candid criticism from its president, Mr. John Cotton Dana, Librarian of the Public Library of Denver. He feared that his enthusiasm for the free public library was born more of contagion than of conviction. In the public library, he said, you have stored a few thousand volumes, including, of course, the best books of all time—which no one reads—and a generous percentage of fiction of the cheaper sort. To this place come in good proportion the idle and the lazy, and also the people who can not endure the burden of a thought, and who fancy they are improving their minds, while, in fact, they are simply letting the cool water of knowledge trickle through the sieve of an idle curiosity. The more persistent visitors are largely men who have either failed in a career, or never had a career, or do not wish a career.

Mr. Dana charged the free public library with relieving the idle, the incompetent, and the indifferent reader from the necessity—would he have books—of going to work to earn them. It checks, he continued, the serious reader in collecting a library of his own adapted to the wants and tastes of himself and his family. It leads parents to regard with indifference the general reading of their children, just as the free public school may lead them to be indifferent to their formal education.

This and much more in the same strain was loudly applauded by Mr. Dana's large and representative audience of librarians. It is evident that the abuses of free public libraries have led to much searching of heart among their chief officers. They are feeling, as the teachers of the public schools also feel, that they can not take the place of the parent who abdicates from one of the primary responsibilities of parenthood. A child whose father and mother hand over its mental and moral culture to the teacher and the librarian virtually becomes an orphan. Neither public school nor public library can do its duty toward its pupils and readers without the hearty and intelligent co-operation of parents. Mr. Dana's address was clearly intended to traverse the easy optimism and self-gratulatory vein usual in presidential utterances. His criticisms will bear fruit in pointing to the abuses and losses inevitable when the form of gratuity is impressed upon a comfort or a luxury which each should buy for himself. The form of gratuity is a form only; at great and increasing cost a service is proffered which should be rendered, not in the free public library but in the home; or, if a compromise must be made, then by the free public library watchfully directed from the home.

Scientific Literature.

SPECIAL BOOKS.

THE vivisection question has not yet created nearly as much stir in America as it has in England, where it has long been a rival of the Deceased Wife's Sister controversy as a provoker of agitation and rhetorical discharges. It has, however, recently come into view here through an attempt to induce Congress to pass a bill imposing severe restrictions on vivisection in the District of Columbia. For the reason above stated England is our chief source of literature on the subject, and in a little book by Sir *Benjamin Ward Richardson*,* which comes opportunely to hand, we have a calm and philosophical examination of the main question at issue. Each of Sir Benjamin's chapters is a reply to one of nine questions submitted to him from the Leigh-Brown Trust, which holds an endowment for a biological institution from which painful experiments are to be excluded, hence the scope of the book is somewhat limited. The first question propounded to him is, "In view of the difference of organization between man and the lower animals, do you consider that painful experiment has played any indispensable part in the study of medical substances and methods for the cure of disease?" He answers this in the negative; "because," he says, "if what has seemed to be indispensable had never been thought of, some other plan equally good would or might have led to the same results." Yet he holds that every experiment hitherto performed for the prevention or cure of such a disease as cancer has been justifiable. Hence his complete answer is, briefly, "Experiment may be expedient, it is not indispensable." The second question asks about anæsthesia in particular the same that the first does about all medical substances. Sir Benjamin answers with an unqualified negative; but as he has made a special study of anæsthetics, having tested so many as twenty-nine, he goes on to give a brief history of anæsthesia and then to point out some still unfilled wants in this field. In answering the question, "Do you approve of the instruction of students by means of experimentalism on living animals?" he states that he taught physiology in a medical school for many years without experiments and his classes got on well. Afterward he introduced a few experiments, which were rendered painless, and found that they required so much time as to crowd out other subjects; that two students rarely saw the phenomena in the same way; and that some students were led to give undue attention to the matters that were illustrated experimentally. He therefore abandoned the experiments. The eighth question relates to legal restrictions on vivisection. It appears that there is a license law in England similar to what the American vivisection prohibitionists are trying to have enacted for the District of Columbia. Sir Benjamin condemns it utterly. He says that "it prevents men of really original mind from working out valuable original inquiries. Men like William Harvey, Thomas Willis, John Hunter, or Wilson Philip could never have worked under it." Further, that most of the objections to it "are minor when com-

* Biological Experimentation. By Sir Benjamin Ward Richardson, M. D., F. R. S. Pp. 170, 16mo. London: George Bell & Sons; New York: The Macmillan Co. Price, $1.

pared with the demoralizing and degrading action of the law upon the noble profession of medicine. This law places the professors of medicine in the same position as the licensed publican, and for the same reason." And again, "it tempts weak men to weak practices; increases the number of experimentalists; makes experiments all but useless, and does not limit cruelty." There are, however, some restrictions to which Sir Benjamin has no objection.

Such laws are mainly advocated by the various "humane societies," and we turn to documents issued by several such societies to learn their positions on the question. The *Thirtieth Annual Report* of The American Society for the Prevention of Cruelty to Animals, of New York, shows that the efforts of that society in 1895 were restricted to stopping and remedying maltreatment of horses and other domestic animals. Vivisection is not mentioned. A letter to its secretary asking the position of the society on this matter has brought no response. A pamphlet on *Work Accomplished by the Toronto Humane Society during 1887–'91* shows that this society has covered a wider field. It has labored against abuse of beasts of burden, cruelty in the transportation of live stock, overloading horse cars, improper horseshoeing, the use of the check-rein and burr-bit, killing insect-eating birds and robbing their nests, killing birds for women's hats, clipping horses and docking their tails, cutting dogs' ears and tails, trap-shooting of pigeons and other birds, matches for cock and dog fighting, bleeding live calves periodically, plucking live fowls, and dehorning cattle. This society also protects children. Here, again, is no mention of vivisection. If these aims are not sufficient for any humane society it might add efforts against the slaughter of seals and other animals for their furs, robbing eider ducks' nests of down, killing small game birds which yield insignificant food supplies, caponizing cockerels, gelding horses without anæsthetics, hunting solely for amusement, especially where the birds or animals are bred for the purpose, the prolonged process of killing food animals required by the Hebrew theology, deserting or "losing" cats by families changing their residences, and confining animals in menageries so that they sicken and die prematurely. These things, as well as those previously mentioned, have not, like vivisection, the purpose of increasing knowledge, but cater only to the appetite, the vanity, the amusement, or the over-exacting convenience of men and women. The American Humane Association is one society that has busied itself with vivisection. It has been taking a census of opinions from clergymen, authors and editors, educators, and physicians of over fifteen years' practice—more than two thousand in all—by sending out statements of four differing views from which a choice could be made. Its replies from clergymen and authors carry little weight, as presumably none of these gentlemen ever saw a vivisection; and those from educators, excepting what teachers of biology there might be among them, are scarcely better. Only the physicians can be presumed to know what they were talking about, and of these there were for vivisection without restriction, 220; for vivisection when restricted to useful ends and under careful supervision, 513; for vivisection restricted and supervised by law, if it be without pain, 186; for the total prohibition of vivisection, 207; obscure or evasive, 24; total, 1,150. It thus appears that there is a wholesome difference of opinion on this subject among mature physicians, but that more of them favor vivisection as reputable men of science would voluntarily con-

duct it than any other of the four views. It is creditable to the reason of the persons of other occupations consulted that this group is largest in each class. The bill which is now awaiting the attention of Congress is meddlesome and impracticable. As shown by Dr. Charles W. Dabney, Jr., Assistant Secretary of Agriculture, in a letter to Senator McMillan, it would seriously hamper the researches of the United States Bureau of Animal Industry, and it has been condemned, among other societies, by the American Medical Association, the Association of Military Surgeons of the United States, the National Academy of Sciences (which was founded to advise the Government on scientific matters), the Association of American Medical Colleges, the Association of American Physicians, the Medical Society of the District of Columbia, the Joint Commission of the Scientific Societies of Washington (and several of these societies separately), and the American Academy of Medicine. The greatest mischief of such a law is that it would be used as a precedent for similar laws in the several States, and, what the vivisection prohibitionists incautiously avow, as an "entering wedge" to bring in more drastic measures. America is in a fair way to make vivisection literature of its own.

Our present knowledge of the ice age affords an admirable example of reconstructing the past from the present as practiced by geologists. The process by which this reconstruction is effected, the facts relied upon, and the reasoning employed in it are given especial prominence in the recent volume on *Ice Work*, by Prof. *T. G. Bonney*.* In order to show us what glaciers are and how they act, the author takes us first to the Alps. He points out the lines of *débris* and the occasional large bowlders carried by the frozen streams, and describes the moraines, giants' kettles, and other traces left by them. Going down the valleys below their present limits, he shows how deposits and marks of erosion testifying to their former greater extent can be identified. Such marks and deposits are found in other lands hundreds of miles from existing ice streams or any mountains that seem adequate to send forth glaciers of great extent. An ice sheet stretching across a continent must be assumed to account for these phenomena, and Prof. Bonney next shows us the ice fields of Greenland and the antarctic lands as evidence that this assumption is warranted. Leaving existing examples of glacial action, our author draws attention to various traces of the Glacial Epoch—lake basins, the parallel roads of Glenroy, eskers, etc. In dealing with phenomena whose meaning is not settled, he has first set forth the facts and then has given the leading rival interpretations of these data, pointing out in what particulars each seems to him strong and in what weak. Traces of ice work are numerous in the British Isles, and nearly one third of the volume is devoted to descriptions of them. In the northeast of England there are the Cromer till, contorted drift, and upper bowlder clays on the Norfolk coast, and similar deposits in Yorkshire, especially in the vicinity of Flamborough Head. In the northwest the Cumbrian Mountains and the adjacent lofty fells of the Pennine range obviously have been occupied by glaciers, and the mountainous part of North Wales affords evidence of similar import. The detached mountainous

* Ice Work, Present and Past. By T. G. Bonney. International Scientific Series. Volume 74. Pp. 295, 12mo. New York: D. Appleton & Co. Price, $1.50. London: Kegan Paul, Trench, Trübner & Co.

mass of Moel Tryfaen presents an interesting study for the glacialist, and there is a remarkable inland deposit of sand, shells, and bowlders, quite recently discovered, at Gloppa, near Oswestry. The midland counties also have their bowlder clays, and deposits extend southward to the neighborhood of London. Four chief sources of streams of bowlders are recognized in Great Britain—Kirkcudbrightshire, the English lake district, Wasdale Crag, and the Arenig region of North Wales, each of which is briefly described. Our author next presents the two rival theories as to how Great Britain received its glacial deposits—one that they were dropped from ice floes floating over the land while it was temporarily submerged, the other that they were dragged on to it by an ice sheet moving over it while it was at or about its present level. After referring briefly to evidence in Scotland and Ireland, Prof. Bonney proceeds to describe ice work in Europe and other parts of the world. For America he gives only the limits and the general character of the traces of glacial action, referring to Dr. G. F. Wright's book in the same series for fuller details. A large number of his illustrations, however, are from American sources. The four remaining chapters are devoted to theoretical questions. Here are discussed the fall in mean annual temperature required for the Glacial Epoch, the possible causes of such a climatal change, and whether there was more than one age of ice. The closing chapter presents some general principles of interpretation of glacial phenomena.

GENERAL NOTICES.

THE author of this suggestive and useful book * admits the deficiency in the teaching of English, and particularly of composition, in our schools, to which attention has been called in a committee report to the Board of Overseers of Harvard College, and attempts here, by a thoughtful discussion of the subject in its theoretical and practical aspects, to point out the way in which the standard of scholarship in the vernacular may be improved. The book has grown out of his own regular work, and its purpose is to state fully and illustrate clearly the principles that underlie all practical language culture, to emphasize the value of such culture—the education that grows directly out of the use and study of the vernacular—to present methods for carrying on the child's instruction in language-arts in harmony with the underlying principles, and to discuss grammar and rhetoric with reference to their educational value and their relation to the language-arts. The results of the best discussions of the subject, from those of the Roman Quintilian to those of Preyer and the American writers, are brought into the study. The language-arts are defined, the value of the vernacular as an educational instrument is estimated, the condition of the child's mind, his acquisition in speech, and the origin of his knowledge are inquired into, and the teaching of the language-arts in the elementary and lower grades and in the higher schools is discussed under the three aspects of the substance of thought, the form of thought, and literature as an art. The principles having been thus established, the subject is considered under the headings of The Art of Reading, Reading and Mental Cultivation, Requisites for Reading, Teaching Reading as an Art, Teaching Reading as Thought, Teaching Composition, Teaching English Literature, the functions severally of English grammar, rhetoric, and criticism, and Teachers of the Language-Arts (qualifications, etc.). A bibliography of twenty-one titles is appended.

In this book * the author considers a subject which he assumes, correctly as far as we know, has not hitherto received any system-

* Teaching the Language-Arts: Speaking, Reading, Composition. By B. A. Hinsdale. New York: D. Appleton & Co. (International Education Series). Pp. 205, 8vo. Price, $1.

* The Evolution of Bird-Song, with Observations on the Influence of Heredity and Imitation.

atic treatment from ornithologists—Mr. Simeon Pearce Cheney, an American, being the only one who has published a special work of any considerable pretensions upon it. Mr. Witchell first thought of making a scientific investigation of it in 1881, while listening to a nightingale, from observing the repetition of a particular feature in its strains. After an interval of some years he became interested in the song of a thrush, and from the thrush was led to observe mimicry in other birds. As his observations were continued, the results assumed shape and now justify embodiment in a book. First he seeks for the origin of the voice, and finds it, with Darwin, in involuntary movements of the muscles—the excitement of combat being a possible occasion. The combat cries are serviceable also for purposes of alarm. A further development in the faculty of song is the call-cry, and from this the transition is not very great to the simplest songs, which are fixed and further developed and varied by heredity and imitation. In the filling out of the plan thus sketched, a chapter is devoted to noticeable incidents connected with bird-song, the influence of heredity is discussed, the causes and effects of variation in bird-song and the influence of imitation are inquired into, and an attempt is made to express the songs of various birds in musical notation, with transcripts of the music sung by blackbirds, thrushes, and skylarks. The book covers a field not occupied by any of the numerous bird books now current, except, in part, by Mr. Cheney's, and will prove an acceptable complement to them.

The *Year-Book of the United States Department of Agriculture for 1895* is the first volume published in accordance with the law of 1895 directing the separation in the reports of the executive and business matter intended for official information and those papers formerly incorporated in them "specially suited to interest and instruct the farmers of the country." We are very glad to find that the editors have sought to make it "a concise reference book of useful information . . . without making it an encyclopædia of general information"—"to make a book and not a mere Government report." It includes a general report of the operations of the department; the papers, presented in the form of popular essays rather than of scientific reports, which are its main reason for being; and an appendix, containing a large amount of miscellaneous matter taken from the reports of the department and presented with special regard to the requirements of the reader.

In the *Nineteenth Report of the Illinois State Entomologist* the first article details a series of experiments for the destruction of the chinch bug. A large portion of the remainder of the work treats of the parasitic and contagious diseases of insects, and details numerous experiments for the destruction of the noxious bugs by means of infecting them with some destructive disease. The last paper deals with the white ant, which it seems annually does much damage in Illinois.

The second of the popular writings of *Thomas Paine* that has been reprinted from the complete works edited by Moncure D. Conway is *The Age of Reason* (Putnams, $1.25). In this form it makes a volume of two hundred pages, octavo. The new edition will doubtless enable many persons to learn that the book is not atheistic, as they have been told, but deistic; that it is not blasphemous, but its whole tenor is, There is one God, and He is too great and good to be charged with the ignorant and wicked acts of men that are recorded in the Hebrew Scriptures.

The Administrative Report of the *Thirteenth Annual Report of the Bureau of Ethnology* (1891, 1892) presents a historical review of the development of the plan of the work of the bureau, which from a seemingly simple beginning has been found to involve some highly complex problems, and in which many lines of investigation have been opened. Seven publications were issued during the year. The general account of the work of the agents of the bureau during the year covered by the report is followed by a general summary of the special papers which compose the larger part of the volume. These papers are: Prehistoric Textile Art in the United States, by W. H. Holmes; Stone Art, by Gerard Fowke; Aboriginal Remains in

By Charles A. Witchell. New York: Macmillan & Co.; London: Adam and Charles Black. Pp. 253. Price, $1.75.

Verde Valley, Arizona, by Cosmas Mindeleff; Omaha Dwellings, Furniture, and Implements, by J. Owen Dorsey; Casa Grande Ruin, by Cosmas Mindeleff; and Outlines of Zuñi Creation Myths, by Frank Hamilton Cushing.

The *Miscellaneous Papers by Heinrich Hertz*, in an authorized English translation by D. E. Jones and G. A. Schott, published by the Macmillan Company, form the first volume of the author's collected works, as edited by Dr. Philipp Lenard. The second volume is a reprint of his Researches on the Propagation of Electric Action (already published in English as Electric Waves), and the third volume consists of his Principles of Mechanics, of which an English translation is in press. The papers here included represent chiefly the earlier investigations which the author carried out before his electrical researches; but the last three—the Heidelberg lecture on the Relations between Light and Electricity, an experimental investigation of the passage of the cathode rays through thin metallic tubes, and a tribute to Helmholtz, are of later dates. Nearly all the papers are extremely technical. In the introduction Prof. Lenard gives a brief history of Hertz's career in investigation, with notices of the occasions on which some of the papers were composed, illustrated by liberal extracts from the author's letters to his parents.

The *Report of the Missouri Botanical Garden* for 1895, the seventh annual report, is a favorable one in all respects. The finances are entirely satisfactory, the receipts from rentals having been increased by $7,500; profitable improvements and valuable additions have been made in the garden; a larger number of visitors by one third were recorded than in 1894, and they "showed no disposition to vandalism"; the herbarium has been added to, and now contains 242,162 specimens, valued at $24,216; besides 4,807 wood specimens and veneers and microscopic slides of woods; and the library contains 20,549 volumes and pamphlets. The scientific papers appended to the report include one by Dr. Trelease on the *Juglandaceæ* of the United States, particularly the hickories, described with reference to their winter characteristics; a study of the Agaves of the United States, by A. Isabel Mulford; an account of the ligulate Wolffias—plants of the Duckweed family—of the United States, by Charles Henry Thompson; an address by President Henry W. Rogers, of Northwestern University, on the Value of a Study of Botany; and a catalogue of the Sturtevant Prelinnæan Library—a gift of early Herbals, Natural Histories, and Medical Botanies, made to the institution by Dr. E. Lewis Sturtevant, of South Framingham, Mass.

The *Annual Report of the State Geologist of New Jersey* for 1894–'95 relates to the Surface Geology, the Archæan Geology, Artesian Wells and Water Supply, and Forestry. In surface geology Prof. Salisbury made a general reconnaissance of the southeastern parts of the State, and Mr. G. O. Knapp of the southwestern; and the field work on the surface formations is now done over nearly all the State. Work was continued over the Cretaceous and Tertiary formations, the Red Sandstone formation, and the crystalline rocks of the Highlands; and special attention continues to be given to artesian wells, drainage, and natural parks and forest reservations. Of the special papers on these subjects we note that on forestry as being most timely and full and definite; and the subject of forest fires receives in it a very satisfactory discussion.

A pamphlet on *Oxides*, the first of a series under the general title, Chemistry at a Glance, has been prepared by *Herbert B. Tuttle*. After some introductory matter on chemical physics, and a list of elements, there follows a list of radicals with a graphic formula for each. About half the pamphlet is occupied by a list of oxides, giving the properties and a graphic formula for each, and there is a similar but shorter list of compounds that the author groups under the name "oxate." (The author, New York, 60 cents.)

The contents of the *Twentieth Annual Report of the Department of Geology and Natural Resources of Indiana* for 1895 pertain almost wholly to economic geology. The introductory portion embodies a general review of the natural fuels of the State (coal, petroleum, and natural gas), its resources other than fuels, its natural history, the condition of the State Museum—which is under-

going a scientific classification—and an account of the office work of the department. The special reports concern the clays and clay industries of the coal-bearing counties by the State Geologist, W. S. Blatchley; the carboniferous sandstones of western Indiana, by T. C. Hopkins; the whetstone and grindstone rocks, by Edward M. Kindle; and the crawfishes of Indiana, by W. P. Hay; besides which the reports of the State natural gas supervisor, the inspector of mines, and the oil inspector for 1894–'95 are given.

Volume XV of the *Bulletin of the United States Fish Commission*—the volume for 1895—consists of ten papers, most of which have also been issued separately. A notably comprehensive study of the habits and development of the American lobster, by Prof. Francis H. Herrick, occupies the first two hundred and fifty pages of the volume. Prof. Herrick has devoted to this subject all the time that he could spare from professorial duties during the past five years, and has used each summer the facilities of the Woods Hole Laboratory. The monograph is accompanied by over sixty finely drawn and engraved plates, a number of which are colored. An account of the attempts to acclimatize fish and other water animals in the Pacific States is the subject of a paper by Hugh M. Smith, M. D. Thirty-one species of fish, the lobster, the Eastern oyster, and the soft clam are mentioned as subjects of these experiments—the best results being obtained with shad, bass, carp, and catfish. Shorter papers deal with salmon investigations in Idaho, oyster beds of Alabama, the menhaden fishery, etc.

The *Chief Fire Warden of Minnesota* has issued his *First Annual Report*, and the document gives evidence of able and energetic work on his part during the year 1895. It contains a copy of the act under which protection of the forests and prairies of the State from fire has been organized, a copy of a warning placard, eighteen thousand copies of which were printed on cloth and posted in the districts liable to fires, a list of the town fire wardens, and statistics of forest and prairie fires in 1895. Owing to wet weather the year affords a much smaller record of destructive fires than 1894. A valuable and interesting feature of the report consists in answers of local wardens to questions as to the effect of the placards, the sentiment of their communities as to forest preservation, and ways in which fires can be prevented more effectually; also answers from lumbermen to a set of questions on present methods of lumbering. Means for preventing the starting of fires by sparks from locomotives, and other topics, are also discussed.

Volume V of the *Report of the Iowa Geological Survey*, 1895, is accompanied, like its immediate predecessor, by reports on six counties of the State. Each of these reports describes the geological formations of the county, and gives the location and character of its economic deposits. Of the latter the most valuable are the soil and its water supply, although this fact is frequently overlooked, and there are also clays, building stone, and some coal.

Among recent bulletins of the University of Wisconsin is one on *The Problem of Economical Heat, Light, and Power Supply for Building Blocks, Schoolhouses, Dwellings, etc.*, by *G. A. Gerdtzen*, B. S. From the engineering standpoint the author discusses the relative efficiency of electricity, steam, and gas in furnishing heat, light, and power, and arrives at a result which favors gas produced by a combination of retort and water-gas processes.

We heartily agree with the view of Locke quoted in the front of the new edition of *Alfred Ayres's Verbalist*—"If a gentleman be to study any language, it ought to be that of his own country." Science and the mother-tongue have been firm allies in the conflict against the monopolistic pretensions of the classics, and each rejoices in the other's success. If one has anything to say, The Verbalist will help him to say it in the most effective way. While the book is mainly concerned with pointing out errors in the use of words, it gives also instructions in punctuation and in the use of the figures of speech, and there are helpful articles on British against American usage in both diction and pronunciation, misplaced words, the use of Latin phrases, threadbare quotations, verbiage, etc. In its new edition the book has nearly fifty per cent more matter than it had on its first appearance fifteen years ago, and, although the words treated are arranged

alphabetically, an index has been added to insure the ready finding of every bit of information that the volume contains. (Appletons, $1.25).

The Wagner Free Institute of Science, of Philadelphia, issues in Volume IV of its Transactions a memoir by Dr. *Joseph Leidy* on *Fossil Vertebrates from the Alachua Clays of Florida.* Dr. Leidy was engaged on this memoir at the time of his death, and it has been completed and edited by Frederic A. Lucas. The specimens on which it is based are chiefly the bones and teeth of a species of rhinoceros and of a mastodon. Others pertain to three species of llama, to two of hippotherium, to a tapir, another species of rhinoceros, a mastodon, and a megatherium.

The chief articles in Nos. 4 and 5 of the *Bulletin of the Department of Labor*, May and July, 1896, are chapters iii and iv of the papers on Industrial Communities, by W. F. Willoughby, describing respectively the village of the Coal Mining Company of Blanzy, France, and that of the Iron and Steel Works of Friedrich Krupp, Essen, Germany. No. 4 contains also an article on the Sweating System, by Henry White, General Secretary of the United Garment Workers of America, in which statistics and abstracts of recent legislation are given. In No. 5 there is a set of statistics and an abstract of laws passed since 1885 concerning convict labor, which brings the greater part of the information in the special report of the department on this subject, made in 1886, down to date. Both numbers contain currrent information on a variety of other matters affecting labor.

Mr. *George Haven Putnam* has brought out a second edition of his *Question of Copyright* (Putnams, $1.75)—a book that is at once a valuable manual and a memorial of a noble struggle for honest dealings with foreign authors. The new edition brings the record of copyright laws in the chief countries of the world down to March, 1896; it contains a chapter on the results of the United States law of 1891, a summary of lawsuits concerned with the international provisions of that law, and other new matter. In a preface to the new edition Mr. Putnam, while admitting that our law works better than the friends of international copyright expected, points out ways in which he believes it should be modified.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Hatch Experiment Station (Mass.): Bulletins Nos. 40 and 41. Analyses of Manurial Substances and Licensed Fertilizers, and on the Use of Tuberculin.—New Hampshire College: The Tent Caterpillar.—Purdue University (Ind.): Commercial Fertilizers.—United States Department (Weather Bureau): Climate and Crop Service for August, 1896.

Bailey, L. H. The Nursery Book (third edition) New York and London: The Macmillan Co. Pp. 365. $1.

Bedell, Frederick. The Principles of the Transformer. New York and London: The Macmillan Co. Pp. 416. $3.35.

Brinton, Daniel G. The Myths of the New World (third edition, revised). Philadelphia: David McKay. Pp. 360. $2.

Britton, N. L., and Brown, Addison. An Illustrated Flora of the Northern United States, Canada, and the British Possessions. New York: Charles Scribner's Sons. Pp. 612.

Bulletins, Catalogues, etc. Brigham, A. P.: Syllabus of a Course of Five Lectures on Physical Geography for the Cook County Teachers' Institute held at Chicago University, August 31 to September 4, 1896.—Proceedings of the American Philosophical Society, August, 1896.—Sixth Annual Directory of the Scientific Alliance of New York, 1896.—Washington Agricultural College and School of Science, Catalogue for 1896:

Clarke, W. H. Cheerful Philosophy for Thoughtful Invalids. Reading, Mass.: E. T. Clarke & Co. Pp. 41. 50 cents.

Cochrane, Robert. The Romance of Industry and Invention. Philadelphia: J. B. Lippincott Co. Pp. 295. $1.25.

Cohn, Dr. Lassar. Chemistry in Daily Life. (Translated by M. M. Pattison Muir.) Philadelphia: Lippincott & Co. London: Grevel & Co. Pp. 324. $1.75.

Compayré, Gabriel. The Intellectual and Moral Development of the Child. Translated by Mary E. Wilson. New York: D. Appleton & Co. Pp. 298. $1.50.

Corrigan, Severinus J. The Constitution and Functions of Gases. St. Paul: Pioneer-Press Co. Pp. 159.

Day, William C. The Stone Industry in 1895. (United States Geological Survey publications.) Washington: Government Printing Office. Pp. 61.

Dresser, Horatio W. The Perfect Whole. Boston: George H. Ellis. Pp. 259. $1.50.

Education, Report of the Commissioner of, for the Year 1893-'94. Washington: Government Printing Office. Pp. 1061.

Harley, Lewis R. Three Typical Educational Systems. Philadelphia: University of Pennsylvania. Pedagogical Series, Vol. I, No. 1. Pp. 57.

Hertwig, Oscar. The Biological Problem of To-day. (Translated by P. Chalmers Mitchell.) New York: The Macmillan Co. Pp. 148. $1.25.

Jordan, David Starr. Notes on Fishes little Known or New to Science. (Leland Stanford, Jr., Publications.) Pp. text, 43; plates, 23.

Life-Saving Service of the United States. Annual Report of, for Year ending June 30, 1895. Pp. 500.

Mach, Ernst. Popular Scientific Lectures. (The Religion of Science Library, No. 21.) Chicago: The Open Court Publishing Company. Pp. 313. 35 cents.

Oxford, Henry. Modern Optical Instruments. New York: Macmillan. London: Whittaker & Co. Pp. 100. 80 cents.

Reprints. Bolton, H. Carrington: Bad Features of Periodicals (Address before the Washington Library Association).—Keen, W. W., M. D.: Gangrene as a Complication and Sequel of the Continued Fevers (Boston Medical and Surgical Journal, July 2 and 9, 1896), and The Treatment of Traumatic Lesions of the Kidney (Annals of Surgery, August, 1896).—Keyes, Charles R.: The Bethany Limestone of the Western Interior Coal Field (American Journal of Science, September, 1896).—Old South Leaflets: No. 67. The Boston Ebenezer, by Cotton Mather; No. 69. Description of the New Netherlands, by Adrian Van der Donck; No. 71. Columbus's Memorial to Ferdinand and Isabella; No. 73. The Battle of Quebec.

Sizer, Nelson. Uncle Sam's Letters on Phrenology. New York: Fowler & Wells. London: L. N. Fowler & Co. Pp. 145. 50 cents.

Smithsonian Publications. Bendire, Charles: Life Histories of North American Birds. Ill., pp. 518. Goode, George Brown, and Bean, Tarleton H.: Oceanic Ichthyology. Ill., pp. text, 552; plates, 123.—Hodgkins Fund Publications, 1033: Argon, a New Constituent of the Atmosphere, by Lord Rayleigh and Prof. William Ramsay, and Methods for the Determination of Organic Matter in Air, by David Hendricks Bergey.

Thorpe, T. E. Humphry Davy, Poet and Philosopher. New York: Macmillan & Co. Pp. 240. $1 25.

Trowbridge, John. What is Electricity? (International Scientific Series.) Pp. 309. $1.50.

White, Andrew D. Fiat Money Inflation in France. New York: D. Appleton & Co. Pp. 86. 25 cents.

Wise, P. M. A Text-Book for Training Schools for Nurses, with an Introduction by Dr. Edward Cowles. New York and London: G. P. Putnam's Sons. 2 vols. Pp. 230 and 337. Each, $1.25.

Fragments of Science.

Notes from the American Association.—The attendance at the Buffalo meeting of the American Association—three hundred and thirty—was the smallest in its recent history. A curve with very marked indentations published in Science shows that the attendance on the meetings has steadily decreased since it reached its maximum in 1880 to 1884. The curve further shows that it was very much greater when the association met in the larger Eastern cities—Boston, Montreal, Philadelphia, New York, Washington, and Brooklyn—though declining in them too, than in the cities farther west. Among the resolutions passed by the association were, one urging upon Congress the desirability of further legislation looking to the early adoption of the metric system; one authorizing the construction of authentic standards of electrical measurement, to be the property of the association; a resolution approving the proposition to create the office of Director-in-Chief of Scientific Bureaus and Investigations in the Department of Agriculture, "to be filled by a broadly educated and experienced scientific man, provided that such appointment shall be made only on the nomination of the National Academy of Science, the legally constituted adviser of the Government in matters relating to science"; and a protest to Congress against legislation on vivisection. In this protest the association declared that experiments on animals "have effected a saving of many millions of dollars in animal property, and are the basis of our knowledge of hygiene and preventive medicine, and, in part, of surgery"; and affirmed that, "while deprecating cruelty and needless vivisection experiments in the public schools, this association believes that those who are trained to biological research are the ones who are best able to decide as to the wisdom and utility of animal experimentation." A committee was appointed to consider the matter of instituting a study of the white race in America. Grants were made of one hundred dollars for a table at the Biological Laboratory at Wood's Hole, Mass.; fifty dollars to Francis E. Phillips for investigations on the properties of natural gas; and fifty dollars to L. A. Bauer for investigations on terrestrial magnetism in connection with the magnetic survey of Maryland. A happy adjustment was suggested, and partly carried out in the case of one of them, of the relations of the special societies to the association, under which, after the formal meeting of the special society, the papers contributed by members shall be held over to be read in the meetings of the association. The societies, by following this plan, may be made to contribute to

the strength of the association and to the interest of its meetings.

New Elected Officers of the American Association.—The following are the officers elect for the next meeting (Detroit, 1897) of the American Association for the Advancement of Science: President: Wolcott Gibbs, of Newport, R. I. Vice-Presidents: (A) Mathematics and Astronomy, W. W. Beman, of Ann Arbor, Mich.; (B) Physics, Carl Barus, of Providence, R. I.; (C) Chemistry, W. P. Mason, of Troy, N. Y.; (D) Mechanical Science and Engineering, John Galbraith, of Toronto, Canada; (E) Geology and Geography, I. C. White, of Morgantown, W. Va.; (F) Zoölogy, G. Brown Goode,* of Washington, D. C.; (G) Botany, George F. Atkinson, of Ithaca, N. Y.; (H) Anthropology, W J McGee, of Washington, D. C.; (I) Social and Economic Science, Richard T. Colburn, of Elizabeth, N. J. Permanent Secretary: F. W. Putnam, of Cambridge, Mass. (office, Salem, Mass.). General Secretary: Asaph Hall, Jr., of Ann Arbor, Mich. Secretary of the Council: D. S. Kellicott, of Columbus, Ohio. Secretaries of the Sections: (A) Mathematics and Astronomy, James McMahon, of Ithaca, N. Y.; (B) Physics, Frederick Bedell, of Ithaca, N. Y.; (C) Chemistry, P. C. Freer, of Ann Arbor, Mich.; (D) Mechanical Science and Engineering, John J. Flather, of Lafayette, Ind.; (E) Geology and Geography, C. H. Smyth, Jr., of Clinton, N. Y.; (F) Zoölogy, C. C. Nutting, of Iowa City, Iowa; (G) Botany, F. C. Newcombe, of Ann Arbor, Mich.; (H) Anthropology, Harlan I. Smith, of New York, N. Y.; (I) Social and Economic Science, Archibald Blue, of Toronto, Canada. Treasurer: R. S. Woodward, of New York, N. Y.

The President's Address at the British Association.—The opening session of the Liverpool meeting of the British Association, September 16th, was witnessed by about three thousand persons. Sir Douglas Galton, the retiring president, in introducing the new president, Sir Joseph Lister, spoke of the occasion as marking the termination of his own services to the association which, as general secretary and finally as president, had extended over a quarter of a century. The presidency of Sir Joseph Lister, who is also President of the Royal Society, offers the first case in which a surgeon has held this position in the body solely in virtue of his professional attainments. It may well be so, for those attainments, as Sir Douglas Galton observed, "have been mainly devoted to mitigate suffering, and have revolutionized the surgeon's art"; and an English journal is moved to declare him "one of the greatest, if not *the* greatest, benefactor mankind has ever had." The new president's address was devoted to the illustration of the Interdependence of Science and the Healing Art, and began with an estimation of the value of the aid the Röntgen rays may render to the surgeon and physiologist. The fact that this is the jubilee of anæsthesia in surgery brought that subject properly forward. Next, the speaker referred to the researches of Pasteur on fermentation and his disproval of spontaneous generation as leading up to his own application of aseptic surgery, the development and ultimate method of which he described briefly and with remarkable clearness. The work of Robert Koch, Pasteur's attenuated virus and artificial immunity, the centenary of vaccination and Pasteur's application of the principle in rabies, Behring and Kitasato's antitoxic serum and its use in diphtheria, and Metchnikoff's investigations of the phagocytes, or white corpuscles, and their power to counteract infection were presented as specimens, culled from a wide field, of what the art of healing has borrowed from science and contributed to it.

The Sectional Addresses in the British Association.—In the sectional meetings of the British Association, Prof. J. J. Thomson, in Section A, made The Teaching of Physics the subject of his presidential address; Dr. Ludwig Mond, in the Section of Chemistry, reviewed the History of the Manufacture of Chlorine, with especial reference to the influence which the progress of pure science has had upon its development and simplification; Mr. J. E. Marr, of Cambridge, in Section C, spoke of Stratigraphical Geology and the effect which the work done upon the subject has had upon our knowledge of geology considered as a

* Died since his appointment.

whole; Prof. E. B. Poulton, in the Section of Zoölogy, discussed the difficulties which arise from both the physical and the biological points of view in considering the subject of organic evolution, and inquired whether the present state of paleontological and zoölogical knowledge increases or diminishes those difficulties; Major Leonard Darwin, of the Royal Geographical Society, described what has been done for railway construction in Africa and what remains to be done if the continent is to be opened up, and sought to indicate the relation of the proposed railway routes to the main physical features of the countries they are to traverse; Mr. Leonard Courtney, M. P., in the Section of Economic Science and Statistics, presented a qualified defense of individualism as opposed to the principles of collectivism; Sir Douglas Fox, in the Section of Mechanics, sketched the progress that had been accomplished in the several departments of civil and mechanical engineering during the quarter of a century since the association last met in Liverpool; Mr. Arthur J. Evans, in the Section of Anthropology, dealt with the Origins of Mediterranean and European Civilization, supporting the "Eurafrican" theory in contradistinction to the Aryan theory; Dr. G. H. Scott, in the Botanical Section, presented an Exposition of the Scope and Functions of Modern Morphological Botany.

The Tree-Emblem of the Sioux.—In a paper on The Emblematic Use of the Tree in the Dacotan Group, read as a vice-presidential address before the Anthropological Section of the American Association, Miss Alice C. Fletcher, after showing how the religions of the Indians probably began with the utterances of a seer, which, passing from mouth to mouth, gradually developed into ceremonials with their rites, spoke of the thunder as the universally accepted manifestation of Wa-kan-da, the mysterious power permeating life. This idea was connected with the thunder birds, and they lived in cedar trees. The pole of the cedar tree therefore became an emblem of the highest value, so that the ceremonies of the sacred pole were of the greatest importance. The development of this idea slowly through many years is a most interesting part of the story of the Dacotans.

Rainfall and the Forms of Leaves.—Observations made by Stahl at Buitenzorg, Java, and recorded in his book on Rainfall and the Forms of Leaves, establish the fact that the points and indentations of leaves are elongated and made more slender by the action of rain; that leaves under its influence tend to assume a vertical position; that the nerves are modified into little channels through which water can flow easily; and that the arrangement of the down on leaves and stems contributes to the scattering of the drops. Other observers, Lundström and Wille, for example, had already pointed out some of these facts, but Stahl's work presents new points of view and contains very instructive details. The morphological peculiarities described are explained by Stahl as results of the necessity of relieving the leaves from their load of moisture, of turning the water to the roots and freeing the tops of the plants from it, of freeing the leaves from epiphytic algæ, fungi, and lichens, and of drying their surfaces rapidly, thereby making transpiration more easy. The distinctive feature of leaves exposed to seasons of rain is the elongation of their points, and this form appertains not to tropical plants only, but also to those which grow on the beach and receive the spray from the sea, to plants on high mountains and elevated plateaus which are wet by heavy dews, and to plants of the temperate zones growing where the precipitation is considerable. New and interesting observations on this subject are contained in a work recently published by Jungner. Some of the most original of them relate to the influence exercised by the spray of waterfalls on the plants that grow in the gorges, below or by the side of the falls. Plants situated thus are styled in German *Träufelspitzen*, or drip-pointed. In the leaves exposed to the spray, their usual down, which would tend to retain the moisture for some time, disappears from the leaves; and the grouping of the leaves on the stems is observed to be favorable to the passing away of the water. These effects may be produced experimentally; and it is possible, in greenhouses, to modify the shape of leaves by exposing them constantly to a fall of water or to spray. Jungner's experiments all tend to the support of the modern ideas concerning adaptation. These conclusions were reviewed

in papers read at the recent meeting of the American Association by Prof. D. T. MacDougal.

Meteorology and Sacrilege.—A recent debate in the Volksraad, at Johannesburg, on the subject of artificial rain-making has some scientific interest for the psychologist. The report is as follows: "The debate on the memorials from Krugersdorp requesting the Rand to pass an act to prevent charges of dynamite being fired into the clouds for rain was continued. Mr. A. D. Wohnaraus spoke in favor of his proposal, and denounced the action of certain persons in Johannesburg as invoking the wrath of God. Mr. Birkenstock said there was nothing irreligious or sacrilegious in these experiments; they were purely scientific experiments. The chairman said it was a monstrous thing to shoot into the clouds; it was nothing less than defiance of the Almighty; it should be made a criminal offense. Mr. Labuschagne was of the opinion that the offenders should be imprisoned. After a further discussion it was resolved, by fifteen to ten votes, to instruct the Government to draft a law to prevent such things happening in future, and submit it this session."

A Cambodian Lesson in Anatomy.—M. Adhémard Leclère, in his examinations of Cambodian schools, came upon a retired scholar-bonze who continued to teach in his rural retreat. He was giving lessons on anatomy to six students of a religious vocation, describing the bones of the human body. He said: "There is a bone in the tongue, which you do not know of, which you have never seen, but which nevertheless exists, for I have seen it. The most surprising thing about it is that it is isolated, and not attached to any other bone. It is all alone." The teacher had given a lesson on the Pali language the day before, and the day before that on the world as described in the sacred books, and also according to what he had heard from Europeans concerning it. "He showed me," says M. Leclère, "on his blackened tablet, a map of the world which he had drawn according to the best of his knowledge. I had some difficulty in recognizing France among all the round marks he had drawn, for it was larger than India, surrounded by water on all sides, and placed northwest of the Himalaya Mountains. 'My map,' he said, 'is not like the map in the sacred books, but it is true all the same.' I did not dare tell him, before his pupils, that it was not like our maps; so I asked him to go on with his lecture, and said I was very glad to be present. The students, each with his palm-leaf tablet and his iron-pointed stylus, listened quietly and respectfully, writing down the names of the bones as he mentioned them. 'The bones of the back are boxed into one another like the bones of a snake or of a fish; if there was only one bone, you would not be able to bend yourself gracefully, or to bend back, or to round your back or to turn yourself. At the slightest shock the bone would break, and you would not be able to carry anything heavy. If the bones of the back were imperfectly boxed, they would not roll upon one another, or else they would roll too much; and your body would be too stiff or too supple, and you would not be able to carry anything heavy.' While he was speaking thus I was looking at him. His body was bare; his long, bald head was slightly inclined toward his hearers, and his bright eyes had an expression befitting an old professor seeking to be correctly understood. He spoke slowly, pronouncing distinctly, and in dignified language; and his six students looked at him attentively, trying their best to understand all he said."

Wire-Glass.—Some instructive tests of wire-glass as a protection against fire were recently made by the Philadelphia Fire Underwriters' Association. Wire-glass consists of a more or less open meshwork of wire imbedded in glass plates in such a manner, it is claimed, that—under conditions where, unsupported by the wire network, the glass would speedily be shivered, and of no use in retarding the fire—the wire-glass interposes a barrier which, even when heated to incandescence and then drenched with cold water, still retains its effectiveness. A brick test house, about three feet by four feet, inside measurement, and nine feet high, was constructed. In one side of this structure a wire-glass window was fastened in a wooden frame covered with lock-jointed tin. In another side a Philadelphia standard fire door was hung. The upper part of this

door had a pane of wire-glass, eighteen by twenty-four inches, set into a wood, metal-covered frame. The entire roof of the test house was replaced by a skylight. One side of this skylight was provided with three lights of a quarter-inch ordinary rough glass; the other side with three lights of a quarter-inch wire-glass. In order to make the test as severe as possible, iron grate bars were placed in the bottom of the test house, and openings were left in the wall near the ground for the purpose of free draught. The house was filled two thirds full of wood, liberally treated with coal oil and resin. In a few moments after the fire was started the ordinary rough glass began to crack and fall into the fire. The wire-glass in the fire door soon became red hot, so that a piece of paper held against it on the outside was easily ignited. The three plates of wire-glass in the skylight, subjected to the entire heat of the fire, also became red hot, but retained their position throughout the test. At the end of thirty minutes water was thrown on the fire and glass. After the fire was extinguished the three plates of glass in the skylight were found to be cracked into countless pieces, but still adhered together, forming one sheet. The window-light—which, as the result showed, was not properly secured to its frame—was found to be in the same condition as the skylight, excepting that a large crack had developed. The plate of glass in the fire door was cracked the same as the skylight, but, being well secured, it did not give way.

Constitutionality of Time Labor Laws.—The general trend of the decisions of courts, cited by Mr. S. D. N. North, in his paper on Factory Legislation in New England, concerning laws limiting the hours of labor, is against their validity. They are regarded as attempts to limit the constitutional right of freedom of contract. But some of the decisions are conflicting. The Illinois Supreme Court has decided that the effect of a law of this kind would be to deprive men of liberty and property. The Supreme Court of California declared an eight-hour ordinance of the city of Los Angeles simply an attempt to prevent certain parties from employing others in a lawful business and paying them for their services, and a direct infringement of the right of such persons to make and enforce their contracts. In Nebraska, an eight-hour law was held to be unconstitutional, as being special legislation, and as attempting to prevent persons legally competent from making their own contracts. In Illinois, an eight-hour law for women in clothing factories was declared to be unconstitutional because it interfered arbitrarily with the right to buy and sell labor. The mere fact of sex, the court held, would not justify the enactment of limiting legislation, unless there may appear "some fair, just, and reasonable connection between such limitation and the public health, safety, or welfare proposed to be secured by it." These facts are used by Mr. North as an argument against further attempts to limit the conditions of labor by legislation, lest the test of constitutionality should be pushed to the extent of overthrowing the restrictions we already have and accept as just.

Indians of the Paraguay River.—An interesting account is given by an Italian artist, Cavaliere Guido Bozziani, of two Indian tribes dwelling on the Paraguay River, among whom he spent some time, whose civilizations are very different. The Chamacocos are a people of noble stature and fine appearance, wearing no clothing "except rough sandals of peccary skin when on the tramp and a profusion of feather ornaments and necklets of reeds, etc., on festive occasions," and excel in feather work, forming combinations of great beauty with the variously bright-colored plumage with which the region supplies them abundantly. They have, too, the singular taste of making much use of rattlesnakes' rattles for ornamental purposes, wearing them with feathers in diadems, armlets, and leglets, bunching them into pendants for earrings, and tying them on axes and clubs. During their dances they use as rattles small gourds containing stones and belts made of loosely strung carapaces of tortoises or the hoofs of stags. Their pottery is all hand-made and rude. Their weapons and implements are long-handled stone axes—quite singular—plain clubs, wooden spears, large bows for shooting arrows pointed with hard wood, and small bows with a double string,

shooting clay bullets, and used for catching birds. The women make bags of netting, and hammocks. They have superstitions about their food, among which is the prohibition of deer flesh to the women, who have to satisfy themselves with birds and small game; and of the eggs of the South American ostrich to the children. The Caduveos, Mbaryas, or Guaycuru, are a warlike and agricultural people, with fixed residences, and have the art of weaving, excel in pottery, and execute designs of wonderful beauty and variety. These qualities are regarded by the author as real results of a logical study of the harmony and æsthetic combination of lines and figures, and not of accidental combinations. Ornamental designs are painted on their skins with the juice of a plant producing a blue-black color, which penetrates the epidermis a little way, and lasts six or seven days. It is applied by women, with small sticks, to the end of which tufts of cotton wool are sometimes tied. The effect of the painting is often heightened by adding powdered charcoal to the juice. The people wear their hair short and well combed and greased; file their upper incisor teeth to a point; practice depilation; are very cleanly, bathing often; and wear decorous clothing and tasteful ornaments.

A Humorous Elephant.—In illustration of the sense of the humorous in elephants, Meredith Nugent, in Our Animal Friends, tells a story of an elephant in the *Jardin des Plantes*, in Paris, that was kept in the same inclosure with a large hippopotamus, for whose comfort and amusement a great stone basin had been constructed and filled with water. "It was quite early in the morning —before the hour for admitting the public to the garden—when I noticed the elephant walking around on the stone edge of the basin curiously watching the hippopotamus, which was completely under water. I felt quite sure that the elephant was up to some prank, and I was not mistaken, for just as soon as the ears of the hippopotamus came into view the elephant quickly seized one of them with his trunk and gave it a sudden pull. The enraged hippopotamus lifted his ponderous head clear out of the water and snorted and blew, but every time he rose to take breath the elephant would recommence his antics. Around and around the great quadruped would go, keeping a sharp lookout for the little ears of the hippopotamus, which he would instantly seize the moment they appeared. His evident delight in teasing his huge neighbor was very comical, and there is no doubt that he thoroughly enjoyed it. Again, one day the keeper placed some food for the hippopotamus in the corner of the inclosure, and at once the animal began to leave the water to get it; but the elephant slowly ambled over to the same corner and, arriving there first, placed his four feet over the favorite food in such a way that the hippopotamus could not get at it, gently swayed his trunk back and forth, and acted altogether as though he were there accidentally, until the garden was thrown open to the public, and he went forward to receive the daily contributions of bread, cake, pie, etc., which were always offered him by his hosts of admirers."

The Future of Wood Engraving.—Notwithstanding the apparently almost universal supplanting of the old methods of engraving by process illustration, Mr. W. Biscombe Gardner affirms that wood engraving was never more alive as a fine art or in a higher state of perfection than it is at the present period; "and it is still capable, in the hands of right, good, earnest workers, of being lifted to a much higher position." Process may hold the advantage for work that has to be done in a rush, and for that in which cheapness rather than quality is sought, but "wood engraving as a reproductive fine art never can be touched and never will be touched by any process yet invented." It is even "far and away" above any of the higher fine-art processes "in its marvelous versatility of technique, which enables the engraver to translate not only the value but the very individual touch of each artist from whose picture he may be engraving. All processes dependent upon photography are bound to go wrong in the rendering of values, since photography has not yet been brought to such a state of perfection as to master the difficulties of exact color translation. In fact, photography is utterly inadequate in the most simple wash drawings in black and white." While it is admitted that a pen-and-

ink drawing could hardly be better reproduced than by the best process, "nothing does or ever can compare with the work done through the sensitive medium of the eye and hand of man. In fact, I consider wood engraving far better than any or all the reproductive arts, as it stands quite alone in its wonderful adaptability, for any variety of texture one likes can be produced on the boxwood block. This can not be said for either etching, mezzotint, steel, or copper, each having its own methods, great as the masters have been who have worked upon one or the other of these materials. . . . The crowning advantage enjoyed by wood engraving, through which it obtains its immense superiority over all other methods, is that the engraver is enabled to work in both black and white line. . . . Nothing is out of the range of imitation possible to wood engraving. The differences of textures of flesh, silk, satin, cloth, wood, steel, glass, the grain of wood, marble, weather-worn stone, furs and skins of animals, atmospheric effects, foliage of all kinds—all these it can represent, and beyond everything it can render the differences between oil and water color, and can accurately transcribe the old master's work with all its cracks and blemishes from damp and shrinkage." The author looks forward to a great future for wood engraving as a fine art.

The Mescal Ceremony.—At a recent meeting of the Washington Chemical Society Mr. Mooney read an interesting paper on The Mescal Ceremony among the Indians. The mescal plant is a small variety of cactus native to the lower Rio Grande region and about the Pecos River, in eastern New Mexico. Its botanical name is *Lophophora*, or *Anhalonium williamsii*. It is grayish green, club-shaped, and without spines. There is another mescal plant, the maguey of Arizona, with which the New Mexico species should not be confounded. The local Mexican name for the plant is *peyote*, a corruption of the original Aztec name, from which it would seem that the plant and ceremony were known as far south as the valley of Mexico at a period antedating the Spanish conquest. Several related species are described by Lumholtz as being used with ceremonial rites among the tribes of the Sierra Madre. The dried tops when eaten produce such marked stimulating and medicinal results and such agreeable mental effects, without any injurious reaction, that the tribes of the region regard the plant as the vegetable incarnation of the Deity, and eat it at regular intervals with solemn religious ceremony of song, prayer, and ritual. The juice of the cactus has an intensely bitter taste, due to an alkaloid pellotine, which is present to the extent of 0·75 to 0·89 per cent. This alkaloid has recently been investigated by Dr. A. Heffter, of the University of Leipsic. Its composition is expressed by the following formula: $C_{13}H_{19}NO_3$. It seems as a therapeutic agent to have two distinct actions. The first effect is narcotic in nature, owing to a paralysis of the brain; this stage is shortly followed by a tetanic condition, owing to the heightened irritability of the spinal cord. Thus pellotine falls into the pharmacological group with morphine. Prof. Jolly, of the Charité, in Berlin, has made clinical use of it as a narcotic in doses of 0·04 gramme.

Æsthetics in Engineering.—The address of Prof. Frank O. Martin, of the Section of Engineering of the American Association, on The Artistic Element in Engineering, was a plea for consulting beauty as well as utility in engineering construction. The engineer is not so bound by the mathematical traditions of his profession but that he has abundant opportunities to cultivate the æsthetical side. It is not true, as is often supposed at the first thought, that there is a conflict between the utilitarian and the artistic. While the mere application of money will not secure beauty, that feature may often be obtained without additional expenditure, or at most with one that is relatively trifling. As an example in which beauty had considerable influence in matters where it seemed little concerned, Prof. Marvin mentioned an engine room which had been elegantly fitted up, with the result that the engine fell under closer and more minute inspection than it could receive in the ordinary dark room, and was more carefully attended to—and that meant more economy for the owner. Our railroad companies find it advantageous to beautify their stations and cultivate their embankments. The engineer may find a wide field in beauti-

fying municipalities and all public works on which he may be engaged.

An India-Rubber Famine.—The world's consumption of India rubber has been increasing so enormously during the past few years that the time does not seem to be far distant when the demand will greatly exceed the supply. The bicycle is of course responsible for a large part of this increase, and, as the pneumatic tire is becoming more of a necessity every day for all city vehicles, there promises to be a still greater demand hereafter. It is stated that only within the last year has there been any attempt to regulate the gathering of caoutchouc and to stop the wanton destruction of the tree, which it seems is usually cut down, so as to facilitate the collecting of the sap. This puts an end to the productiveness of whole districts every year, and, as it has been found that by properly made incisions about two pounds of rubber can be gathered from each tree annually, without in any way interfering with its growth or life, vigorous attempts are called for, and it is stated are being made, to regulate the treatment of the trees. Owing to the danger of a rubber famine, several chemists in both France and Germany have been working on methods for the artificial production of India rubber, and several new processes have already been announced. Attention has also been turned to the *balata*, a South American tree. This *balata* rubber, while not so good for insulation and other purposes as caoutchouc, is yet specially adapted for a great many uses, such as machinery belting, mackintoshes, surgical appliances, etc., and British Guiana has developed quite an export trade in it, the annual quantity amounting to over three hundred thousand pounds.

MINOR PARAGRAPHS.

A RECENT number of the American Medical and Surgical Bulletin contains an article on the artificial generation of ozone for purifying the air in our public schools. In many cases the schoolroom air is so stale and depressing that before the children have been in it half an hour all their brightness and vim has disappeared, they become listless and sleepy, and are in the worst possible condition for study. This alone would be bad enough, but breathing this vitiated air renders them more vulnerable to the attacks of pathogenic germs, some of which are sure to be present in such a favorable location. Ozone is markedly germicidal and stimulating, and the suggestion, although not a new one, seems worthy of attention.

IT has been decided to erect in one of the squares of Paris a monument to Pasteur, and to make the enterprise an international one. Consequently, the people of all countries will be given an opportunity to participate in the subscriptions. The Paris committee is under the presidency of M. J. Bertrand, Perpetual Secretary of the Academy of Sciences, and has among its honorary members the President of the Republic and his Cabinet, and about one hundred and sixty prominent men of the French nation in all walks. A committee has been formed in the United States, at Washington, with Dr. D. E. Salmon as chairman and Dr. A. E. de Schweinitz as secretary, which gladly accepts the privilege of organizing the subscription and of receiving and transmitting the funds which are raised. "We believe it is unnecessary," the committee says in its circular, "to urge any one to subscribe. The contributions of Pasteur to science and to the cause of humanity were so extraordinary and are so well known and so thoroughly appreciated in America that our people only need the opportunity in order to demonstrate their deep interest." Subscription blanks will be supplied by the committee, and no one who can not give a large sum need be deterred from giving a small sum. The committee's address is at the Cosmos Club, Washington, D. C.

THE *Biologisches Centralblatt*, conducted by Drs. J. Rosenthal, M. Rees, and E. Seleuka, and published semimonthly at Leipsic by Eduard Besald, aims to keep its readers in current with the progress of the biological sciences, and to inform the students of single branches of what is going on in the other and related branches. With a view to that object it presents original communications, particularly those embodying the results of

investigation which are of general interest outside of the bounds of their several specialties, and summaries; comprehensive reviews of the more important events in the progress of investigation, weeding out what is temporary or subsidiary, and presenting only that which is of lasting value and a literary record.

Consul Merritt, of Barmen, is authority for the following statements regarding mineral wool, or silicate cotton, as it is sometimes called. The wool appears on the market in a variety of colors, and is coming to be used very extensively as a non-conductor of heat and also as a protection against fire. It is made by blowing molten rock into a fibrous woolly state by means of a jet of steam. The furnace slag or the rock, as the case may be, is melted in a large cupola, and as it trickles out at the taphole in a somewhat sluggish stream it meets a high-pressure steam jet which blows it into a woolly, fibrous condition, in which state it settles in fleecy clouds on the floor, the heavier wool coming down first, while the lighter portions are blown farther along by the force of the steam. The material thus naturally grades itself.

For an inquiry whether fishes have a sense of hearing, Herr A. Kreidt experimented upon goldfish—normal, fish poisoned with strychnine, and fish deprived of their labyrinths. Sounds were made by sonorous rods plunged in the aquarium, to which tuning forks or bows were applied out of the water. Whistling and the ringing of bells outside of the water produced no impression on either of the three classes experimented upon. But all responded whenever the apparatus within the aquarium was struck with the production of an audible sound. The conclusion was drawn that fish do not hear as in ordinary hearing with the ears, but that they are sensitive to sonorous waves which they can perceive through some skin-sense.

A Mr. Chaplin, in introducing a bill in the English House of Commons, which was intended to ameliorate the widespread agricultural depression, gave some striking facts regarding the present unjust methods of taxing land. One instance, of two men living side by side, each of whom started in life with $100,000. A invested his money in various securities, and now has an income of $2,800 a year. He lives in a house rated at $200 a year, and his rates come to about $22. B invested his capital in a farm, for which he paid $75,000, and afterward put $25,000 in as tenants' capital. His farm is rated at about $2,585, and his rates amount to about $335. Another striking case was that of a factory employing 2,000 hands, rated for local purposes at $2,000. A farm of 200 acres in the same parish is assessed at $2,300, and pays more to the local rates than the factory. Another case cited was that of a farm of 265 acres in Essex, where the rent was only about $76 and the rates $90.

An International Atlas of Clouds has been published under the direction of a committee consisting of M. Hildebransson, of Upsala; Riggenbach, of Basle; and Tesserenc de Bort, of Paris. It contains fourteen plates, each including two or three figures, the several classes of clouds in the classification adopted being represented by from one figure for the "fracto-nimbus" to ten for the cumulus, while some transitional forms are also delineated. The figures have been selected from more than three hundred representations of clouds from all quarters of the earth. The plates have been approved by eminent meteorologists, and their accuracy is guaranteed. In the text are given the definitions and official instructions adopted by the International Meteorological Committee at its meeting in Upsala in 1894.

It is proposed to explore the island or rock of Rockall, which is situated in the open Atlantic, in 57° 36′ north latitude, about two hundred miles west of the Hebrides, with no other land nearer. It is about two hundred and thirty feet in circumference at the base and sixty feet at the top, and looks at a distance like a ship under sail, being whitened by the guano that has been deposited upon it. It appears to be the emerged point of an extensive mountainous submarine table land, stretching from the southwest to the northeast, and giving rise to a number of dangerous rocks and reefs in the neighborhood. It offers advantages of great promise as a meteorological station, situated as it is in the zone of the most extensive area of cyclones in the north-

ern hemisphere, but it is not easy to land upon when the sea is at all rough. It is but little visited. It bears a few plants which have not been collected and studied, and is the resort of numerous sea birds. The curious peak is situated at a greater distance from any mainland than any other isolated rock of like dimensions in any part of the world.

OLD shoes are not lost by any means. In this country they are dissected and subjected to a course of manipulations by which they are converted into a kind of artificial leather, which is made to look very fine, and may be elegantly ornamented. In France they go through a less elaborate transformation. At the military prison in Montpellier the shoes, the majority of which come from Spain, are ripped apart; the nails are drawn out. The parts are softened in water, and are then cut up by a machine into vamps for children's or little girls' shoes. The soles are likewise utilized. The smallest pieces are used to make the Louis XIV toes which were in fashion a few years ago. Pieces a little larger and thinner are made into the soles of babies' shoes. The nails of iron are separated by means of a magnet from copper nails, and the latter are sold for a higher price than the others. The manager of the prison represents that the returns from this manufacture nearly equal the cost of the old shoes.

NOTES.

HON. DAVID A. WELLS'S chapters on The Principles of Taxation, the publication of which has been unavoidably suspended in the October and November numbers of the Monthly, will be renewed in the December number, and regularly continued thereafter.

THE British Association has resolved to invite the president, vice-presidents, and officers of the American Association to attend its meeting next year at Toronto as honorary members; also to admit all fellows and members of the American Association as members of the British Association on the same terms as old annual members—namely, on payment of £1 (or $5), without requiring an admission fee.

IN regard to the proper designation of its vice-presidents, the American Association directed that that term be used in official publications in expressing the relation of the presiding officer of any section to the association, and the term *chairman* in expressing his relation to the section; and that the term *vice president* precede the name of the officer and *chairman* follow it when both relations are to be expressed. When referred to, these officers are to be termed vice-presidents *for*, not *of*, the sections.

PROF. WOLCOTT GIBBS, the new President of the American Association for the Advancement of Science, Rumford Professor and Lecturer on the Application of Science to the Useful Arts, is the oldest living professor in Harvard University, though not now in active service.

A very satisfactory dressing for wounds, consisting of bags of straw charcoal, is used by the Japanese. It fits perfectly to the wounds, and has considerable absorbing power and antiseptic properties. The charcoal is prepared by burning straw in a covered vessel.

A SHRUB in Madagascar, called the *vonimperono*, bears a seed, the feathery tuft of which possesses some of the qualities of silk, and may be found useful in the arts. The flower and the pod, as pictured in *La Nature*, suggest affiliation with the *Asclepiads;* and the tuft does not contradict the suggestion. It is a little more than an inch and a half long; its fibers have considerable strength; and, according to M. Georges Chapin, they form a veritable vegetable silk. The people of the western coast of Madagascar collect it, and, often without taking the trouble to remove the seed, make soft cushions and pillows of it; and the Hova ladies use it for stuffing the seats of their *filanzanes* or sedan chairs.

THE term *roches moutonnés*, used by geologists to describe a peculiar topographic appearance resulting from glacial action, is usually interpreted as meaning resembling a flock of sheep asleep, and that is the explanation given by M. de Lapperent in his geological treatise. The dictionaries, however, define *moutonné* as meaning frizzled like sheep's wool. The term was first used by De Saussure in his *Voyages dans les Alpes;* but the passage had escaped recent observation till Mr. Whymper found it. It reads, translated, "These contiguous and repeated roundnesses produce as a whole the effect of a well-grown fleece, of the wigs which *are called moutonnées.*" Mr. Grenville A. J. Cole in Nature cites this passage to justify his comparison of these shapes to the mammillations upon an antique wig.

A PAPER read some time ago in the Linnæan Society by Mr. R. Morton Middleton, recording the observation of Mr. Miltiades Isigonis of the use of ants by the Greek barber surgeons of Asia Minor for holding together the edges of a cut, brought out the fact that the same custom exists in Brazil as among

these Greeks. The Eastern barbers hold the ant—a large-headed *Camponotus*—in a forceps, when it opens its mandibles wide, and, being permitted to seize the edges of the cut, which are held together for the purpose, its head is cut off as soon as a firm grip is obtained. A similar practice was observed in Brazil several years ago by M. Mocquerys, of Rouen, and is cited by Sir John Lubbock, but it is not mentioned by either Bates or Wallace.

JUDGMENT was recently given in an English court, in the suit of an actress against the Nottingham Theater company for damages for injuries by falling through a dilapidated stairway, on the evidence of an X-ray picture of the injured foot.

THE third volume of Poggendorff's Biographical and Literary Dictionary, now in publication, will contain notices of scientific men in various fields who lived between 1858 and 1883. A fourth volume will cover the years from 1883 to 1900. Full lists of contributions to scientific literature will accompany the notices. The dictionary will contain many names not often heard of, among them those of Arabian philosophers.

EXPERIMENTS are in order to protect letters against exposure by the Röntgen rays. MM. Thayer and Hardtmuth, of Vienna, bronze the inside of their envelopes or ornament them with designs in bronze. It is found that the X rays have only a feeble action through the bronzed envelopes, while in those ornamented with bronze pastes only the spots that are left white are exposed; and in both cases the written characters are not revealed in intelligible shape.

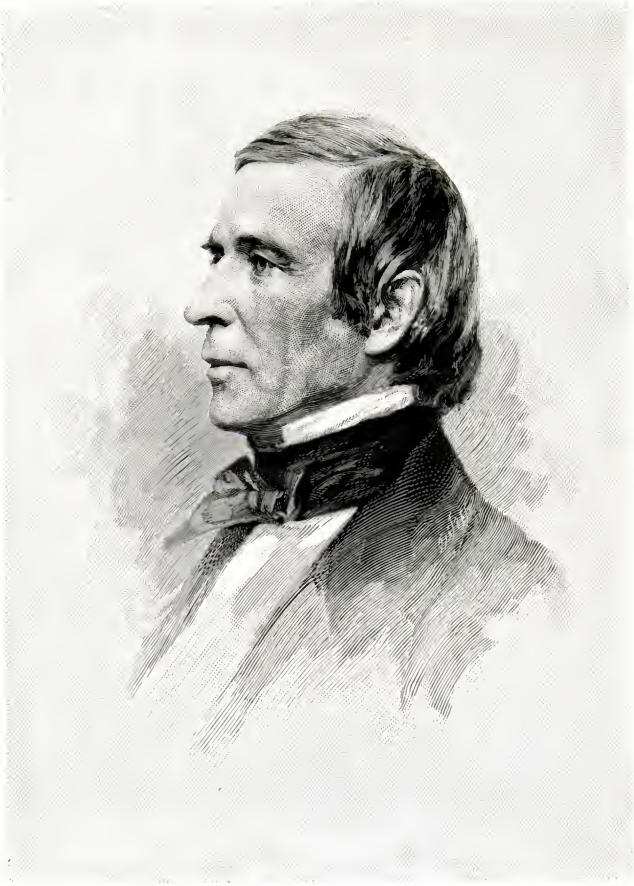
IN an experiment recently made at an Austrian wood-pulp factory to determine how quickly it was possible to make a newspaper from a tree, three trees were felled in the presence of a notary and witnesses at 7.35 A. M. The trees were taken to the factory and cut up into short pieces, which were stripped of their bark and converted into mechanical pulp. This was placed in a vat and mixed with the materials necessary to form paper, and the first leaf of paper came out at 9.34 A. M. Some of the sheets were taken, the notary still watching the proceedings, to a printing office about three miles away; and the printed newspaper was issued at ten o'clock. It thus took two hours and twenty-five minutes to convert a tree into a newspaper.

AMERICAN science has suffered a serious loss in the death, September 6th, of Dr. George Brown Goode, Assistant Secretary of the Smithsonian Institution. Dr. Goode was born at New Albany, Ind., February 13, 1851; was interested in natural history from an early age; was graduated from Wesleyan University in 1870; and made a collecting trip to the West Indies in 1872 and 1873. In the latter year he became connected, on the invitation of Prof. Baird, with the Smithsonian Institution, where he spent the rest of his life. He performed many special services, especially in connection with the interests of fisheries; as director of the Natural History division in the Philadelphia Centennial Exhibition of 1876; United States Commissioner to the International Fisheries Exhibitions in London and Berlin in 1880 and 1883; statistical expert with the Halifax Fisheries Commission in 1877; representative of the Smithsonian Institution at the Chicago Exhibition of 1893; and member of the Board of Awards at the Atlanta Cotton States Exhibition of 1895. Among his published reports and works are those on the Game Fishes of the United States, The Fishes and Fishing Industries of the United States, American Fishes and Oceanic Ichthyology, the Plan of Classification for the World's Columbian Exhibition, and the Museums of the Future.

PROF. HUBERT A. NEWTON, of Yale University, mathematician, and one of the most distinguished investigators of meteors and meteoric showers, died in New Haven, Conn., August 12th. A sketch of his life and his work on the problem of the meteors was published, with a portrait, in the Popular Science Monthly for October, 1885 (vol. xxvii, p. 840). His address as President of the American Association, at the Buffalo meeting in 1886, on Meteorites, Meteors, and Shooting Stars, was published in the Monthly for October, 1886 (vol. xxix, p. 733). Subsequently to these dates, Prof. Newton continued his studies of meteors by the aid of stellar photography, with many interesting and valuable results; and through his exertions a battery of cameras was placed in Yale Observatory for more extensive meteoric photography. His work in mathematics was also of the highest order.

WE announce with regret the death of Prof. J. L. Delbœuf, of the University of Liége, at Bonn, August 13th. Prof. Delbœuf was a student and scientific writer of more than ordinary power to interest, original and genial, and possessing considerable humor. We have published several articles and extracts from his writings; among them are Dwarfs and Giants in the twenty-second and What may Animals be taught? in the twenty-ninth volume of the Monthly; and more recently, Observations on the Psychology of Lizards.

HERR OTTO LILIENTHAL, the inventor of a flying machine with which he had achieved some small successes, was killed during an experiment with his apparatus at Rhinow, near Berlin, August 12th. The machinery became deranged, and the whole concern fell, with Herr Lilienthal, to the ground.



HENRY DARWIN ROGERS.